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HUGO GERNSBACK
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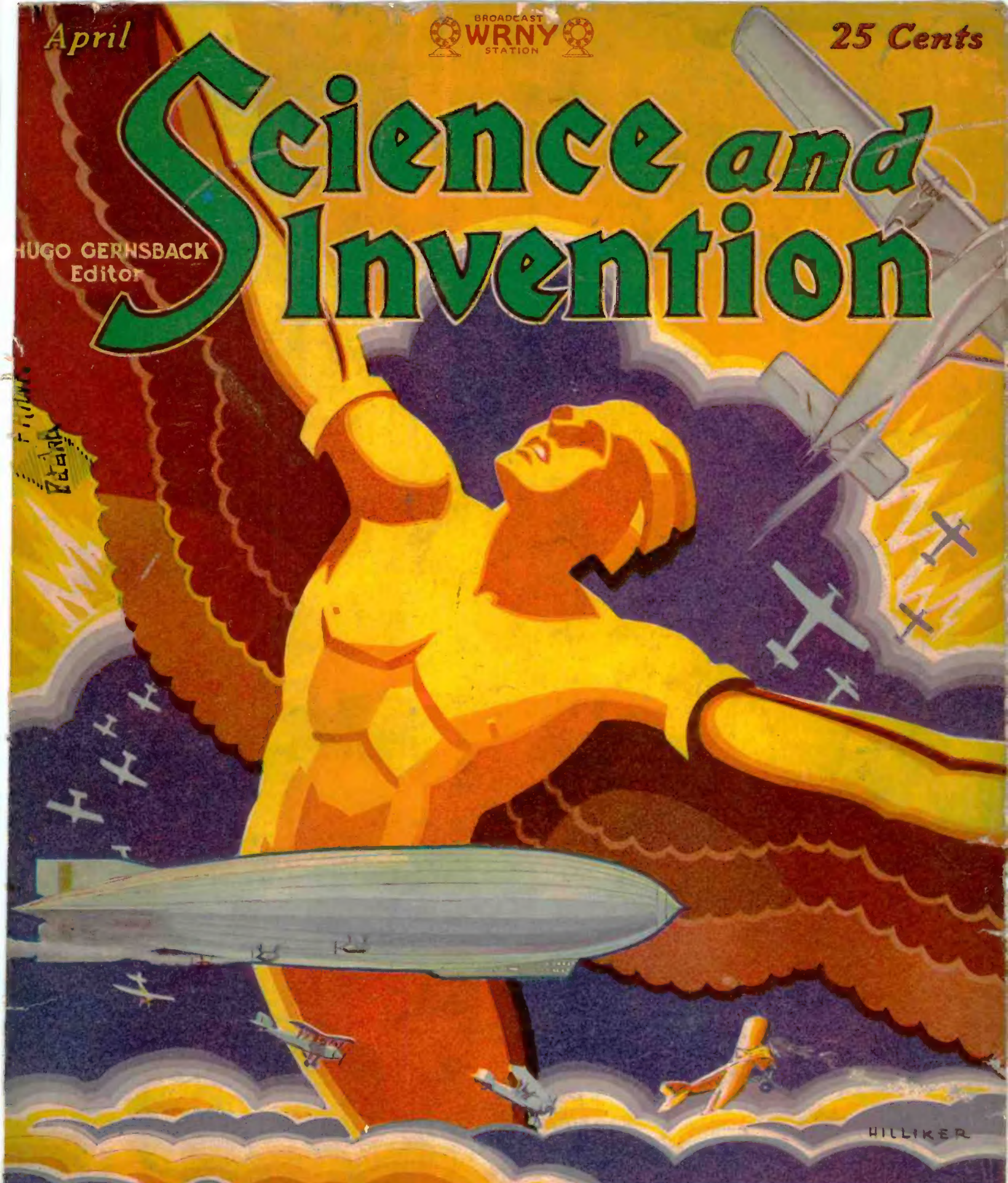

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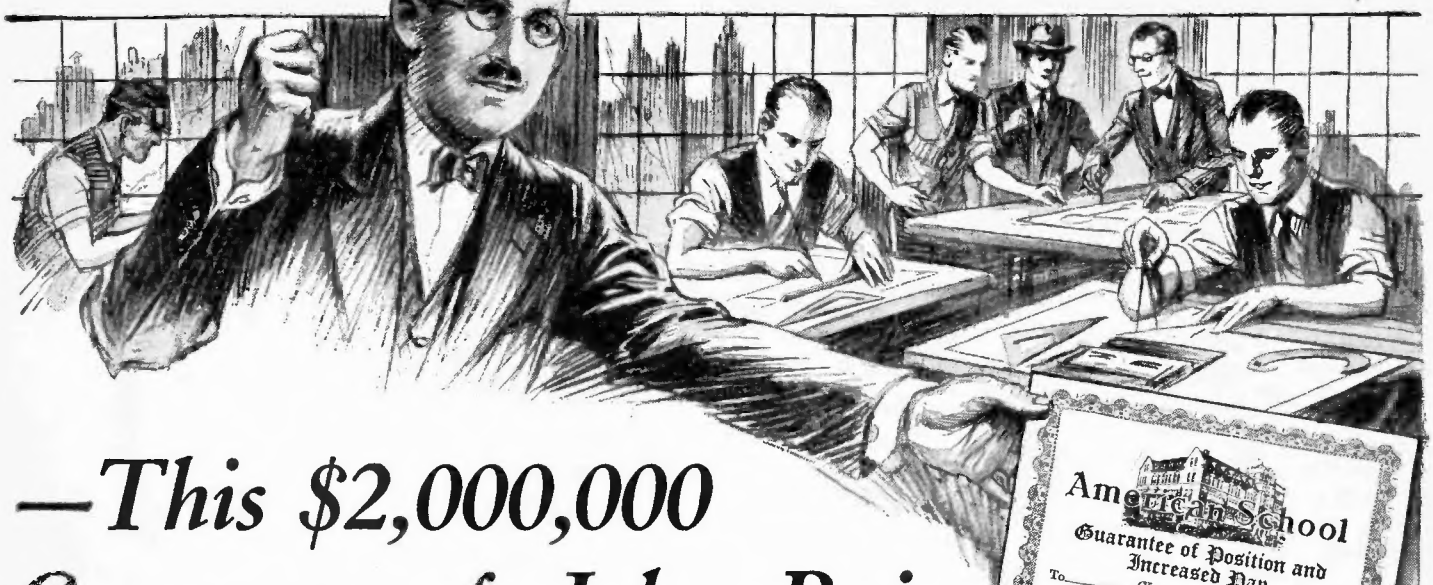

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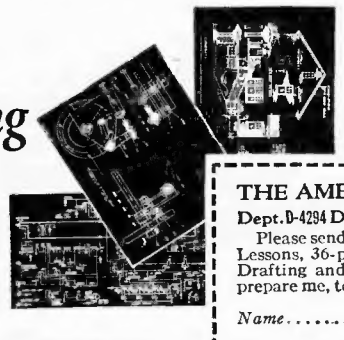

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Science and Invention

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IN OUR NEXT ISSUE

Milk in Paper Containers
Strange as it might seem, science has now given us a highly sanitary paper container which will eventually supplant glass milk bottles.

Could You Qualify as a "Cop"?
You will be entertained and also surprised at the results which you will arive at, after making the psychology tests for the up-to-date policeman.

Evolution!
The third article explaining the fundamental arguments in favor of the evolution theory of man's ascent will be set forth by the renowned scientist, Dr. Ales Hrdlicka.

Tomorrow—What?
The interesting illustrated story of a recent theatrical production which shows us vividly how we may live in the future.

Home-Made Airplanes
In an early number we will present some interesting articles, with drawings, showing how to build passenger-carrying planes. Another interesting construction article soon to appear covers a high-power electric phonograph.

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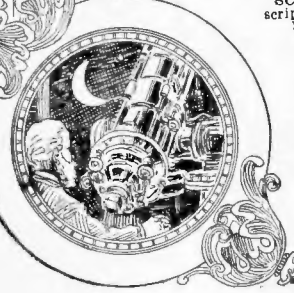

A HANDY RULE FOR YOU

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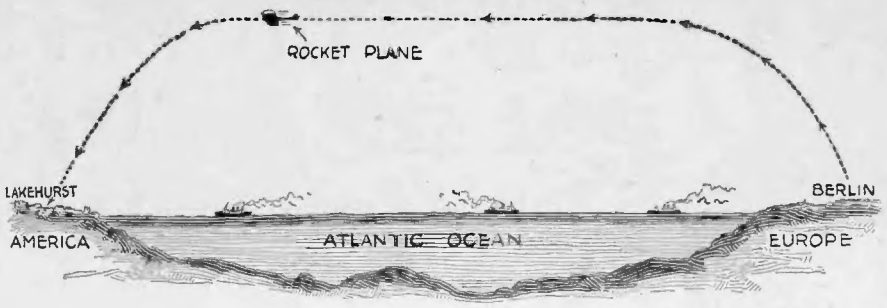


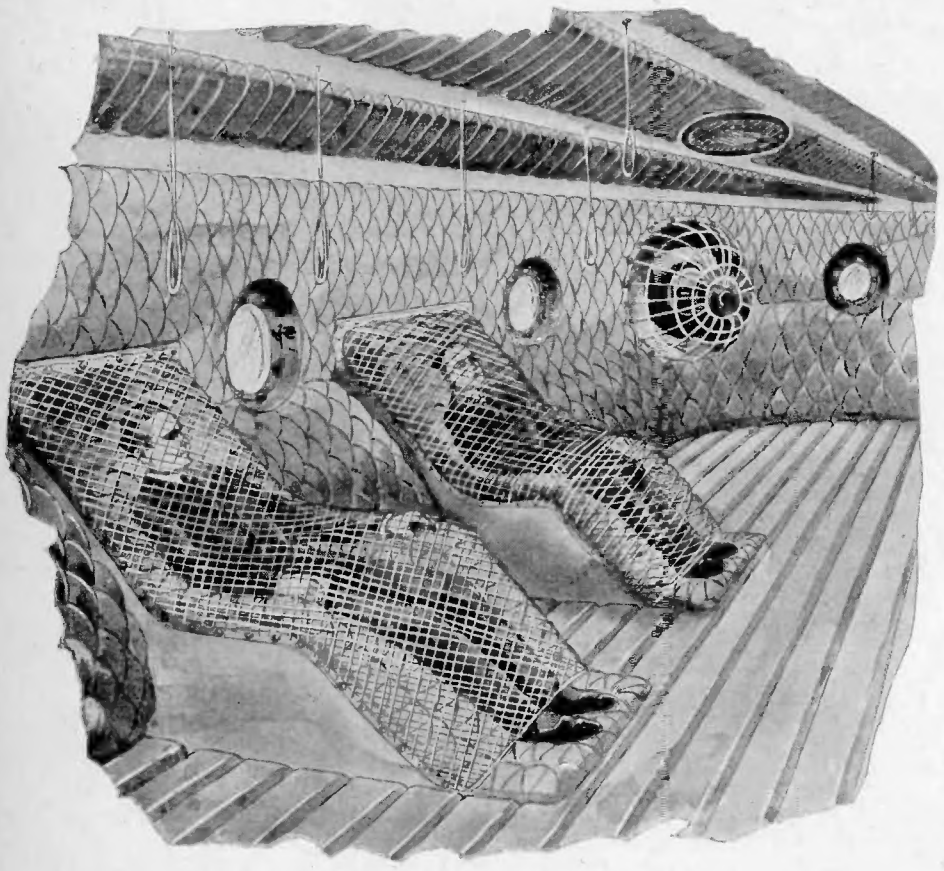
The path which the proposed rocket plane would take in its flight from Berlin to New York is shown above. It would rise by means of propellers and then be driven along a straight course by the rockets.

Unaccustomed to the excessive weight, I had taken too slight a grip on it, and it was jerked out of my hand, flew through the meshes of the net, dragged the watch chain through my button-holes and with threatening noise, struck the wall. Discouraged, I refrained from further attempts at moving, and resigned myself to my fate. Then I suddenly got a violent colic, I thought they were tearing the entrails out of my body, at least that was the way the thing seemed to me! I made the greatest efforts to take my troubles in a more philosophic way, and overcome them, when suddenly the noise of the rockets deafened me. If I had hitherto been pressed against the elastic net of my divan, now I flew like a tennis ball against the other side of my resting place. It seemed to me that I fell from a mountain into a deep canyon, and when I came into possession of my senses again, I found I was holding fast to the net with both hands. The plane seemed to be always falling and I waited with anxiety, every second, for the shock of our rocket chest falling on the surface of the waves of the Atlantic Ocean.

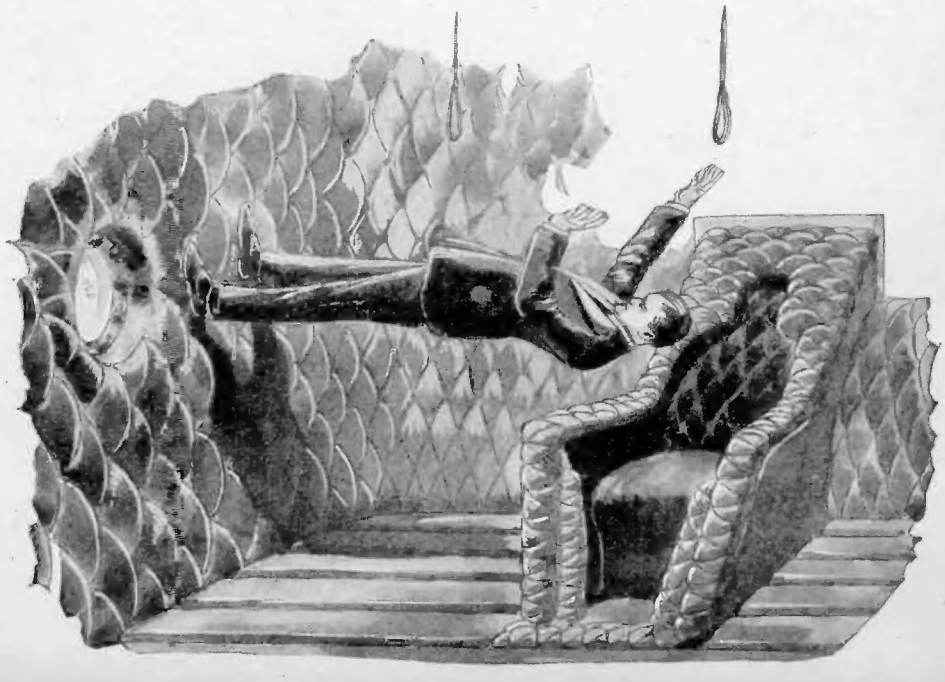
Then through the loud speaker came the voice of the captain, "Twenty minute period without weight! The passengers now can unhook their nets and move about in freedom. Do not let go of your hand straps so that you won't strike anything, and get injured in any way." It was a strange feeling of "weightlessness" not yet experienced that came over me, somewhat as if I had swum some time under water; I didn't know what was up and what was down. I became dizzy and the whole cabin semed to turn diagonally about me, so that I was in the condition of the victim of alcoholism, needing help to leave my bed and stand up. I unhooked my net hastily in order to walk upon the floor—I found that I swept through the space like a ghost. It is somewhat like what the spiritualists would represent the awakening after death to be. Then I suddenly saw the captain of the plane swim around me in the air like a skillful diver. He came directly to the cushions of my divan and helped me to grip one of the hand straps. His appearance brought again to my mind the physical laws of gravity-free condition—I had looked forward to this experience with the greatest curiosity—and now discomfort disappeared, and my interest was aroused.

While the pilot was busy trying to catch the pieces of my watch which were flying around in space, I "hung" myself to the cabin window. I had now returned to my senses, and I was amused at the comic aspect of my present experiences. While upon the side facing the earth the daylight came through the windows only as a dark glimmer, I now looked upon the globe of the sun with its streaming

(*Continued on page* 1184)



Special rubber-padded passenger compartments and chairs constructed to fit the body would be used, with a safety screen stretched over the passenger.



At the right we see the predicament of one of the passengers who has not obeyed orders and fastened himself in one of the safety seats. Due to the great speed, gravity has little influence upon the car occupants.

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Around the World Non-Stop Flights are Demonstrated to be Feasible by the Endurance Flight of the Airplane "Question Mark"

This illustration graphically portrays how passengers can be transferred from a small plane to a speeding trans-continental plane, without the necessity of the larger plane coming to earth. A cable connects the two planes and the passenger sits on a sort of chair-like arrangement regulating his descent by a special clutch gripping the cable.

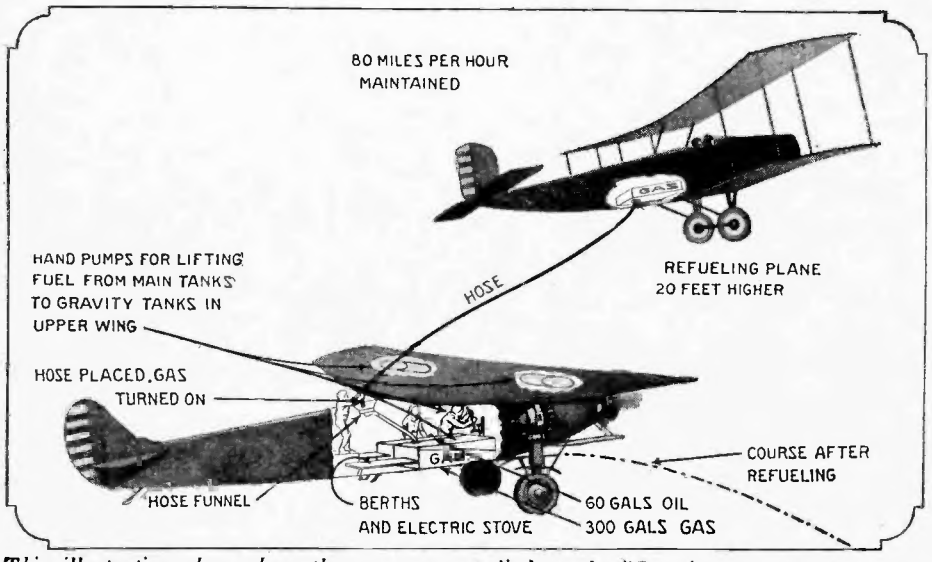
THE QUESTION MARK'S FLIGHT

By JOSEPH H. KRAUS

ON New Year's Day, at 7:26:46 A. M., a plane arose from the Metropolitan Airport at Los Angeles, and its wheels did not again touch the ground until six and one-quarter days later, or to be exact, until on January 7th, at 2:07:01 P. M., thus giving a duration of flight of 150 hours, 40 minutes, and 15 seconds.

The only reason that the plane came down when it did was because of the failure of the left hand engine and the other two engines could not keep the plane aloft after the terrific grind to which they had been put.

There are many questions as to the benefit which aviation will derive from a flight of this nature. It casts grave doubt that engine failure was the cause of many of the ocean disasters which have occurred on projected inter-continental flights. Here is one time when the stamina of the motors was tested to the extreme and in six and a quarter days they could easily have reached any destination. In the six and one-quarter days that the plane remained in the air, the motors were put to a test far exceeding that of any run on a block. The varying air currents, air pockets and stresses incident to flying, as well as the necessity of maintaining the heavily loaded plane in the air, are conditions which no block test can duplicate.


80 MILES PER HOUR MAINTAINED
HAND PUMPS FOR LIFTING FUEL FROM MAIN TANKS TO GRAVITY TANKS IN UPPER WING
HOSE
REFUELING PLANE 20 FEET HIGHER
HOSE PLACED, GAS TURNED ON
COURSE AFTER REFUELING
HOSE FUNNEL
BERTHS AND ELECTRIC STOVE
60 GALS OIL
300 GALS GAS

This illustration shows how the gas was supplied to the "Question Mark." It is fed through a hose, by gravity from the refueling plane above to the "Question Mark" below. This hose is held in place by one of the operators and the gas is conveyed to two tanks and then pumped by means of a handpump into the space provided for it in the upper wing. From here, it feeds to the engines.

While the skill of the pilots of both the Question Mark and the refueling planes, coupled with cold-blooded nerve, remain as monuments to the success of this 150 hour continuous flight, there were many questions involved as to the possibility of night refueling; the length of time that the engines could run continuously in air, and last but not least, the length of time the crew could stand the strain of the continuous gruel of flight, if the elements were constantly fighting against them in the way of fog, storms, winds, and temperature and the motors constant drone were trying their patience to the utmost.

Not a Trick Flight

THE flight made by the crew of the 'Question Mark" was decidedly not a stunt flight. The officers of the plane kept a carefully tabulated record of everything that took place. The crew was composed of Major Carl Spatz, the Commanding Officer; Captain Ira C. Eaker; Lieutenants Harry A. Halverson and Elwood R. Quesada, and Staff Sergent Roy Hooe. Transferring a storage

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What the Flight of the Question Mark Means to the Future of Aviation

battery in air, transferring tons of fuel, and food without an accident, calls for plenty of skill, in the daytime, let alone at night. The ground crew, as well as those who piloted the refueling vessels must be given full credit.

What This Means to the Future of Aviation

MANY disasters in long-distance flights occur at the take-off. The plane is generally loaded with gasoline to capacity. As a result, it requires a favorable wind and an extraordinarily long runway before it can take off into the air. The reader will recall the disaster that befell Captain Rene Fonk while he was trying to take off for a flight across the ocean, and he will also remember the fears that were entertained for Col. Lindbergh's safety by those who watched this take-off. These planes could hold much more gasoline than they did, provided that the field were long enough to acquire speed to lift the ship. The carrying capacity of the ship varies approximately inversely as the square of the speed. Thus an airplane able to take off at a speed of 50 miles per hour with a certain load, can quadruple this load at 100 miles per hour.

Lindbergh's epochal flight from New York to Paris covered a distance of 3,633 miles. If this plane were refueled in air, it could under the same conditions fly for 14,532 miles, but it would have to maintain double the speed of Lindbergh's original take-off speed. This would carry the plane from New York straight to Brisbane, Australia. It is thus seen that refueling a plane in flight is not the only important factor which the flight of the "Question Mark" has developed. It now becomes perfectly possible to take off with a large and lightly loaded plane from a very small field, refuel that plane in air at the start of a tran-oceanic voyage, and have no difficulty in reaching the destination or fear that gasoline will run low. More than enough gas can thus be put on any ship, to permit it to terminate its flight.

If the flight of the "Question Mark" were stretched out, the heavy broken line would indicate the route along latitude 34° north.

Using the same plane, but taking on gasoline to full capacity at the start would have enabled Lindbergh to travel four times as far. The speed of take off must be doubled and maintained.

If the actual flight, as indicated below, is stretched out, it appears as above. It will soon be ridiculously simple to go around the world in less than 80 days.

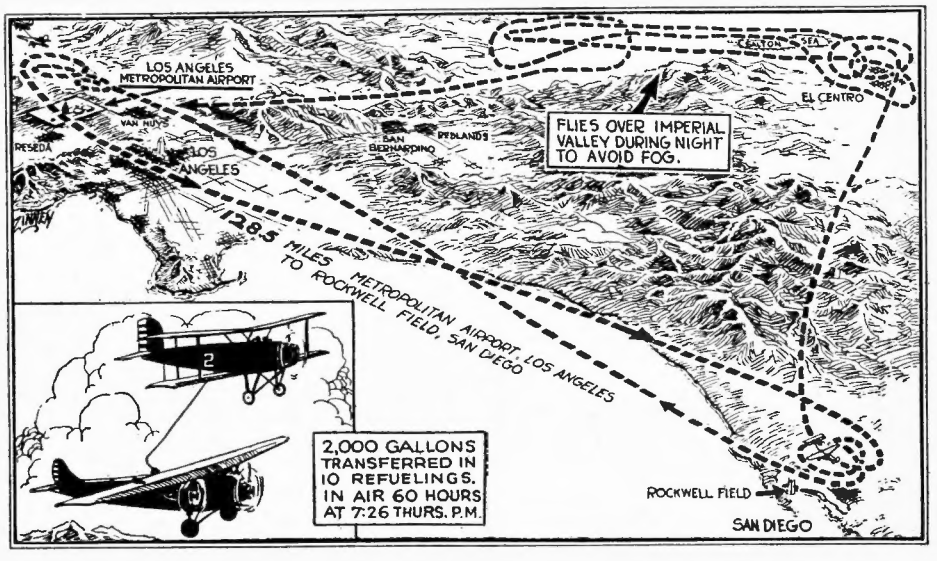
Military and Commercial Aspects

WE must also consider the additional benefits that a flight of this nature gives from a military aspect. It demonstrates that planes are now able to take off with great cargoes of war materials and only a small supply of gasoline, or with a small supply of gasoline alone. The cargo of explosives can be delivered to the plane while in air, and no disaster befall it any more than in the present demonstration. A good quantity of gasoline can then be stored in the plane for a protracted flight across enemy lines. Protracted air skirmishes now become possible over long fronts without the necessity of landing for refueling.

In commercial aviation, the advantages are the carrying of greater cargoes, the transference of shipments while in air, permitting rapid cross country flights, and the decreased wear on both plane and motor by avoiding frequent take-offs. Behind these principal developments lay the technical observations from such protracted flights. Engine weaknesses, plane defects, and other difficulties which might be encountered will all be eliminated.

Around the World

ALREADY the foremost sponsors in the art of aviation are making plans for a non-stop flight around the world. It has been temporarily decided that 20 refueling stations could be located in different cities, one in Chicago, one in New York, for a southern route, or one at Prince Rupert, and Vancouver, Winnipeg, or St. Johns, Newfoundland, for the northern route around the world. The others would be in foreign lands. The possibility of this is indicated in the map. This shows that the "Question Mark" would have flown almost three-quarters of the way around the world at 34° north latitude.



This illustration shows the actual flight of the "Question Mark" between Rockwell Field and Los Angeles. It also shows the course followed over the Imperial Valley during the nighttime so as to avoid fog. The actual time the plane was in flight was 150 hours.

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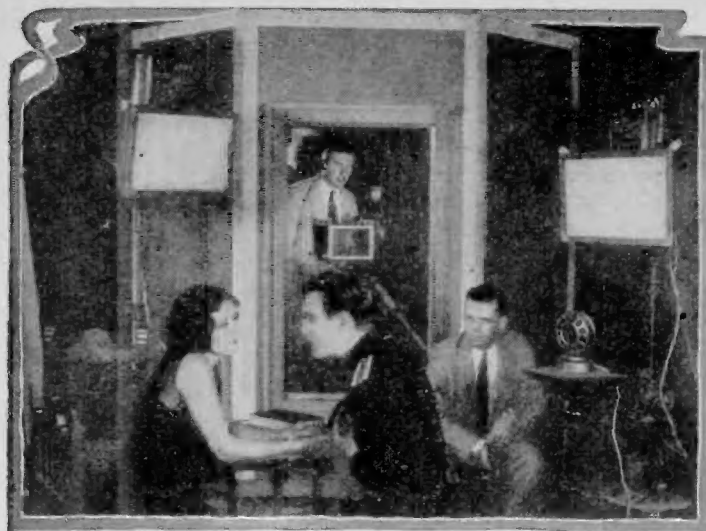
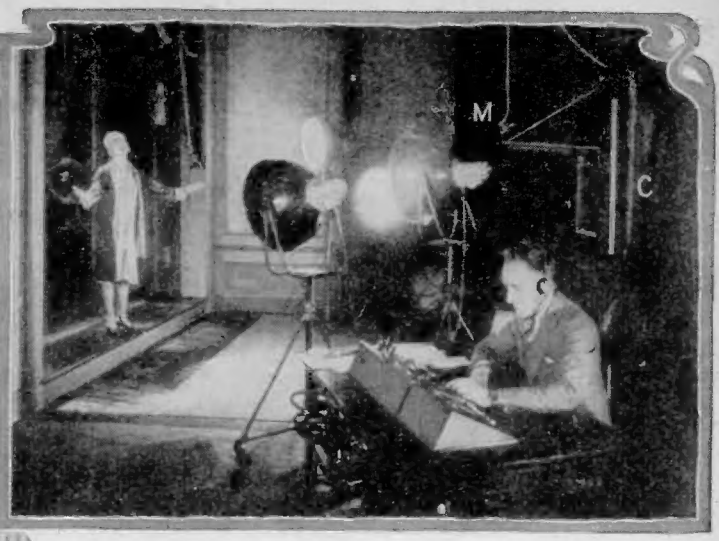
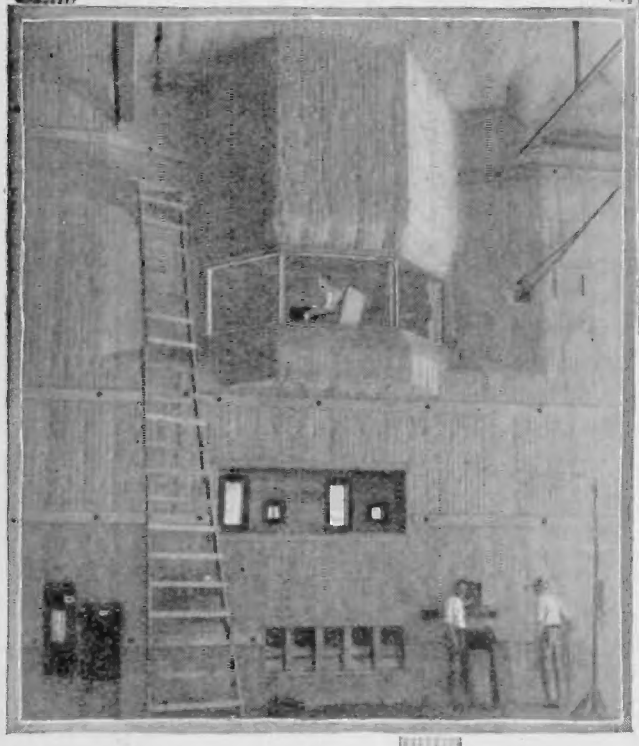




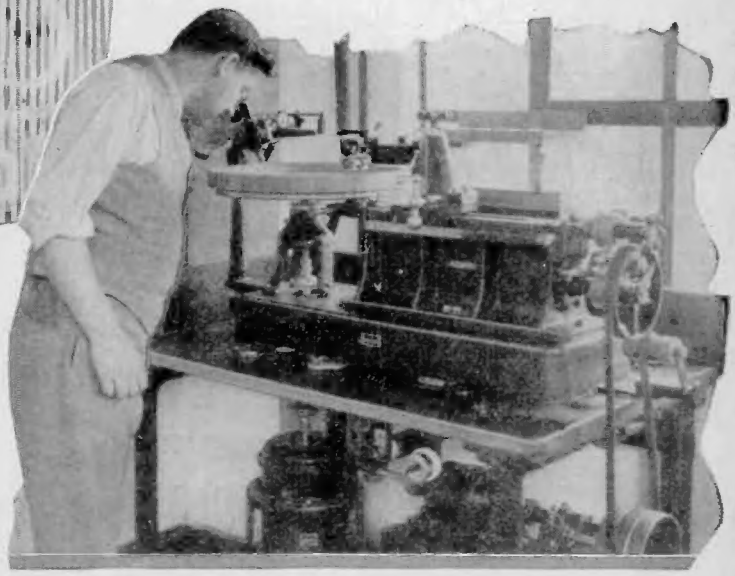
The picture above shows a "talkie" close-up being photographed—the lady is Raquel Torres. At right above—Fannie Brice making a "talkie"; M, microphone; C, camera booth.

Making The

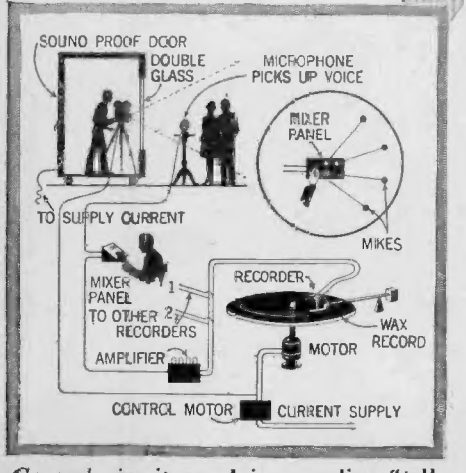
The Mechanics Involved in the Recording Picture Briefly Explained



Heavily padded sound-proof studio for simultaneously recording voice and picture is shown above.



The voice is recorded on a wax record, which man is inspecting. The voice grooves are recorded by an electro-magnet and a needle.



General circuits used in recording "talkies." Sounds from various microphones are modulated at the mixer panel.

THE talking motion picture or the "talkies," as the public has come to know them, have been described from time to time, but there seems to be a great deal of interest manifested by the layman as to just how the voices are recorded in the studio, and finally reproduced in the theatre. In general, there are two principal methods employed in recording and reproducing talking motion pictures. The first method employs a wax disc record similar to the well-known Victrola, and the voice currents picked up by a microphone similar to that used in the broadcast studio, are amplified and fed into an electro-magnetic recorder, into which is fitted a special cutting stylus or needle. In correspondence with the fluctuations of the voice current as the actor talks or sings, there are corresponding fluctuations in the strength of the electro-magnets on the recording machine, and the stylus in turn records a wavy line or groove on the wax record. Once the voice or singing has been recorded on the wax record, it is then played to see if it is perfect, and if not, the record has to be taken over again. Once the record has been made, and the voice or singing is perfect from one end to the other, then duplicate records are made in the usual manner and as many of these duplicates can be made as desired for distribution to theatres throughout the country.

While the actor is carrying out his part, and speaking his lines, the motion picture photographer is recording the actor's photographic likeness on the usual strip of moving film, the camera being placed in a sound-proof cabinet as the photos herewith show.

The motion pictures are taken through a plate glass window or door in the sound-proof cabinet, and these cabinets, or at least some of them, are mounted on casters so that they can be moved around the studio for taking different scenes,

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No Spiritualistic Powers Involved in Obtaining Code Message from Houdini

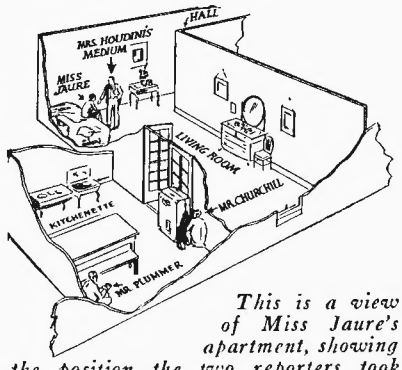
"Rev" Ford Faked Houdini Message

Mrs. Houdini Withdrew $10,000 Offer for Message

By
REA JAURE

Feature Writer New York Evening Graphic, Specially Written for SCIENCE AND INVENTION

The editors of SCIENCE AND INVENTION *Magazine have been repeatedly asked about the truth of the reception of the Houdini spirit message, as announced by the newspapers throughout the country. In an effort to give the facts, the following article is called to the attention of the reader. It may be mentioned that the author, Miss Rea Jaure, on the staff of the newspaper specified, was well known to both Mrs. Houdini and Mr. Ford.*



This is a view of Miss Jaure's apartment, showing the position the two reporters took while Mr. Ford was being questioned.

ON January 8th the press of the Nation startled the reading public with the announcement that spirit communication had been established with Harry Houdini, world famous magician, who died October 31st, 1926.

It was flashed around the world that Arthur Ford, pastor of the First Spiritualist Church, Manhattan, had gone into a trance and through *David Fletcher* his *guide* had received the ten word message Houdini before his death, had agreed with his wife Beatrice, should be the method of communication from the grave, if such were possible.

The message with the code and its translation had been placed in a vault in the Manufacturers Bank on Fifth Avenue, with a view to compare with such proof.

On January 10th, the *New York Evening Graphic*, in a story under my signature, alone announced the communication from Houdini to Ford as a *gigantic hoax!* The *Graphic's* exposure was immediately and vigorously challenged by both Mrs. Houdini and Ford, *who insisted that the communication was genuine!*

Basis of Fraud Charges

IN this story I shall give in detail the facts and circumstances upon which the *Graphic* based its charges of fraud.

The *Graphic's charges were based on two* points: First—that Ford was not only in possession of the code message, but also its translation, days before he went into his trance at the Houdini home, 67 Payson Avenue. Second: Ford's admission to this fact, heard by two unseen witnesses, when he called at the Jaure apartment on the night of January 10th.

The *Graphic* was in possession of the code, its translation and the message 24 hours before the final seance was held! They had been given to me by Mrs. Houdini herself, the day before, at her home where she rehearsed to me the details of the seance and personally explained the method of translating the code.

The story that appeared in the *Graphic* on January 8th, was written the day before, and its release for publication telephoned by me from the Houdini home, immediately on the conclusion of the seance.

This claim will be substantiated by William E. Plummer, Managing Editor of the *Graphic* and the City Editor, Howard Swain.

If Harry Houdini is cognizant of events that transpire in this horribly beautiful world, I am sure he will turn over in his grave, unable to ignore the strong arm tactics of this Spiritualistic hoax.

Houdini's life work was to demonstrate that all so-called spiritualistic phenomena could be duplicated by magic or human means. For two years Beatrice Houdini was deluged with mail from all parts of the world, sent to her by mediums submitting messages from her deceased husband.

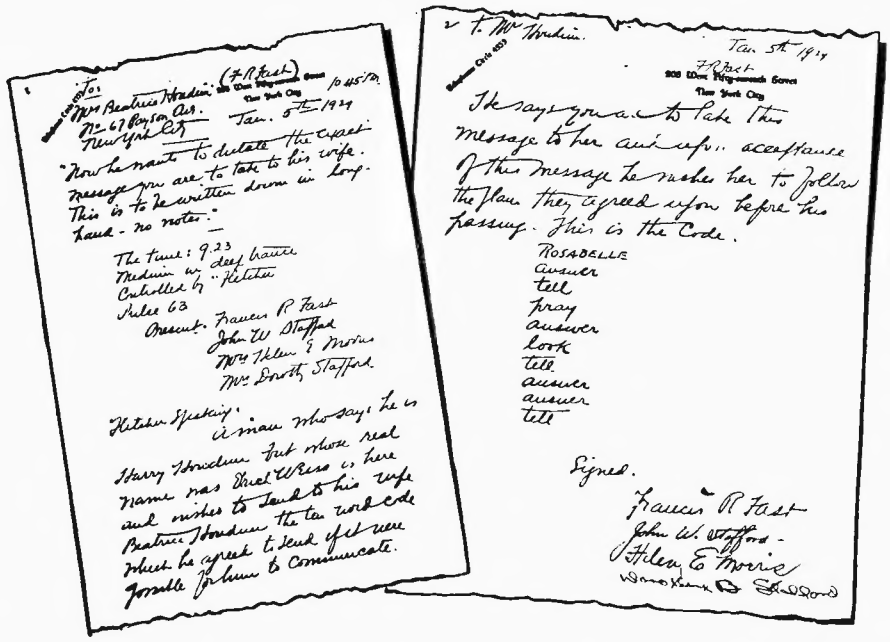
About three weeks prior to the Ford

(*Continued on page* 1203)

A CHALLENGE

AS Chairman of the Investigation Committee of SCIENCE AND INVENTION Magazine and as Psychic Investigator for said Committee, I have made a thorough investigation of the evidence which presented itself in the Houdini controversy. Mrs. Houdini has personally denied being in any way implicated in any fraudulent connection with the so-called hoax. I have spoken to two witnesses who claim that an associate and personal friend of Houdini's, knew what the message was and had boasted of this fact at least six months before this so-called seance materialized. If Ford has secured this message by any spiritual communication with the late Houdini, it would, to my thinking, be a simple matter for him to further his claim, as well as his spiritual reputation, by reading a sealed letter which I have in my possession, which at one time was addressed and written to me by the late Harry Houdini. I have challenged him to do this through the press, and am again repeating my challenge through this magazine.
If his work is genuine and sincere, as he claims it to be, I am sure he would have no objection to accepting this chalenge and collecting $21,000.00 for his time and trouble as well, should he succeed in proving the sincerity of his so-called spiritual ability.

Hugo Gernsback



This is a photographic copy of the letter presented to Miss Jaure, and its significance is given in the accompanying article. The words of the code spell out the word "believe." The word "answer" stands for the letter B; "tell" represents E; "pray answer," a combination of the first and second word of the code refer to the twelfth letter L; "look" is the ninth letter I, etc. The code itself is subsequently given in this article.

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Einstein's Theories Explained and Described in Popular Style. Simple Illustrations Help in Mastering These Most Difficult Problems

SPACE— TIME *and* RELATIVITY

By

DONALD H. MENZEL, Ph.D.

PART II

Sizes are only relative. Gulliver's adventures are reasonably explained by a change in himself.

What Is Space? A Dialogue Between a Relativist, A Physicist and a Layman

The Theory of Relativity

LAYMAN: I should like to learn something about the theory of relativity.

Relativist: Einstein's theory of Relativity?

L: I thought there was only one theory of Relativity.

Physicist: No. Relativity has been discussed for centuries. Einstein's contribution to the theory is very recent.

R: Before I go into details about Einstein's particular ideas, let us first discuss a few general principles. Take space, for instance. What is it?

L: That's easy. It's distance.

P: I might be a little more concrete and say that space is extension. It is usually associated with size. This person is six feet tall. That house is thirty feet high.

R: According to your definition, space cannot exist by itself. You must have a measuring stick and an object to be measured.

L: I can conceive of perfectly empty space.

P: If space were perfectly empty, you would not be there to try to think about it.

R: If space is *extension,* it must obviously extend from somewhere to somewhere else and the extension must be gauged by a measuring rod—say a foot rule. What is a foot?

L: My dictionary says that a foot is equal to twelve inches.

P: That is scarcely a definition unless we know what an inch is. What does the dictionary say?

L: An inch is a twelfth of a foot.

R: How illuminating! That reminds me of Eddington's apt illustration—the incident of the clock and the time-gun in Egypt. The man in charge of the time-gun fired it by the clock and the man in charge of the clock set it by the time-gun.

P: We might say that a foot is the distance between two scratches on a certain bar of invar.*

* Invar is an alloy of nickel and steel, which does not change length with temperature.

If we say that an object is large compared with another, we mean that the second object is small compared with the first. Above, Gulliver is being bound by the Lilliputians.

R: Suppose, then ,that you measured with that bar, the length of a room before going to bed and find that it is fifteen feet long. If, on awakening, you should find it thirty feet long and that every object but the rule appears to have doubled, what would you conclude?

L: I should say that the rule had shrunk to six inches during the night.

R: But you have already said that the standard for twelve inches was the length of the bar. Once you have adopted this as a standard it is hardly logical to turn around and adopt something else, for example, the length of the room, as a standard—especially when you have taken care to provide the most rigid standard available.

L: But, according to your statement, the ruler has obviously contracted.

P: What if everything else in the universe had expanded?

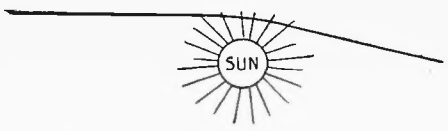
L: I see the difficulty. There is no such thing as absolute measurement. Once we have accepted a standard, all lengths must be taken relative to that standard.

R: Exactly. That is the first step in understanding relativity—that sizes are not absolute. It never occurred to Gulliver that his adventures in Lilliput might have been explained by a change in himself. That would have been quite as reasonable an explanation of the experience.

If the Universe Shrunk

P: Then if everything in the universe were to shrink or expand proportionally we should be unaware of the occurrence.

R: You see that our conception of the universe is not entirely independent of ourselves. We are limited in our explorations not only because of imperfect measuring sticks, but also because our intellects are limited. From infancy to old age our conception of space is continually changing. A baby will reach for the moon as readily as for its rattle. When the child has learned to walk,



A ray of light does not travel in a "straight" line, but is "deflected" by the gravitational pull of the sun.

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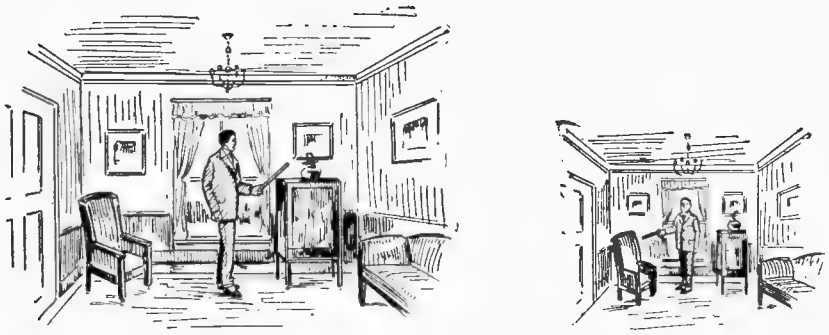


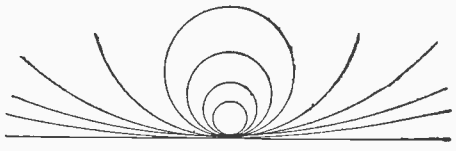
If the entire universe were to shrink in every part, exactly to one-half its present size, we would be entirely unaware of this occurrence, for all our standards of length would be similarly contracted and no measurement could possibly detect the change.

development of his spacial sense begins in earnest, for it is gained only by experience. As he explores his world, he learns the meaning of extension. You see a tiny object; experience bridges the distance and you tell me that it is a house. This second factor, the mentality and experience of the observer, is far more important than appears at first glance. Yet the earth is so small a fraction of the universe that the experience of any terrestrial inhabitant must be limited indeed.

P: That is true. History bears ample witness to the fact. The ancients who argued in favor of a flat earth did so on the basis of their experience.

L: I do not agree with you. I think that there are certain properties of space that exist entirely independently of an observer—geometry, for instance. I should think that two triangles congruent* here would also be congruent at the antipodes.

R: I grant that you *may* be right, but you cannot prove it. How do you test for congruency? Remember your geometry. The theorem starts—"Take one triangle and place it upon the other." How could you do this if you were here and the triangles, as you say, at the antipodes?



Above is a series of circles with radii 1, 2, 4, 8, and 16 cm. in length, etc. The 30th circle would be as large as the earth. Our universe is not infinite and the 96th circle is the largest that could be drawn inside it. Note that the larger the circle, the more nearly does a portion of its arc coincide with the "straight line" at the bottom.

L: Your argument seems rather far-fetched to me.

R: It is highly relevant. You are privileged to talk about the antipodes if you wish, but you must make the measures from wherever you happen to be.

P: I am inclined to agree with our friend—that certain geometrical principles hold throughout space.

A New Geometry Needed

R: That is because you have an idealized idea of what geometry is. You are taught the subject at an early age and, at the time, you believe that you are studying properties of material objects. Not at all! Geometry is concerned with certain idealized conceptions—lines, planes, regular figures—that in all likelihood, do not have any existence outside your imaginations.

Geometry starts with certain fundamental axioms and postulates that cannot be proved. If they happen to be false, any conclusion deduced from them will also be false. Let me enumerate some of them:

1. Any figure may be moved from one place to another without changing its size or shape.
2. A straight line is the shortest distance between two points.
3. Through a given point only one line can be drawn parallel to a given line.

L: To me they seem so self-evident as to require no proof.

R: But are they? Do not for a moment imagine that Euclid assumed them without trying to prove them. He assumed them only because he could not prove them. Take, for example, the first one above. Here is a piece of paper and I move it thus. Does it keep the same size and shape?

L: That isn't fair. You crumpled it in your hand.

R: Why isn't it fair? Your postulate said nothing about that.

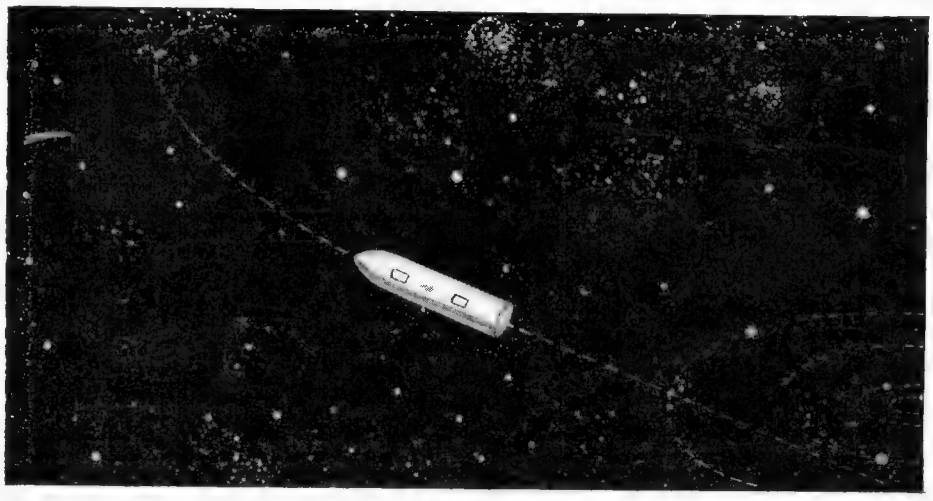
L: The postulate does not allow you to change its shape.

R: That would be a command rather than a postulate. Would you have us rewrite the postulate thus: An object may be moved from one place to another without changing its size or shape, if you do not change its size or shape in so moving it? I think we begin to see why Euclid had some difficulties in proving it.

P: The postulate evidently is misstated. It should read, "Any rigid figure may be moved without changing its size or shape.

R: I should call that a definition of rigidity—Any object that can be moved without changing its size or shape is rigid. And that is not the purpose the postulate was introduced for.

P: In that case, geometry seems to lose its concrete significance, for no object in nature can be moved without deforming it. The most rigid steel bar must yield to some slight degree under the touch of a feather, nor will it ever fully recover from the operation.

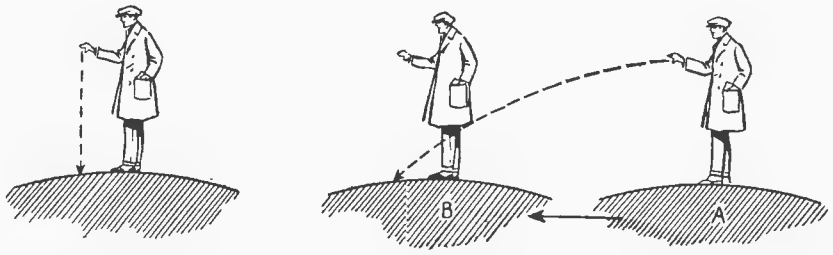


If we were to travel in a Jules Verne rocket projectile, in the straightest line possible, we should in reality be sweeping out a great circle through the universe.

When is a Line "Straight"?

R: That is just the point I wished to make! Geometry is not concerned with nature. It deals with abstract properties alone. Now take the second postulate, which to me is particularly objectionable. How would you tell

(*Continued on page* 1196)



A man on the surface of the earth drops a rock which makes a straight line with respect to the surface of the earth. An observer on the moon would see the rock fall in the above dotted curve, for the man, who is at A when he drops the rock, will be at B when it strikes, owing to the relative motion of the earth and the moon.

* Of exactly the same size and shape.

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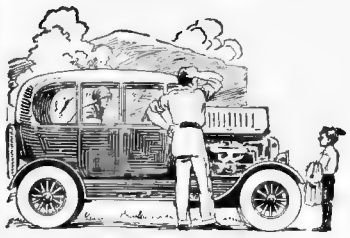
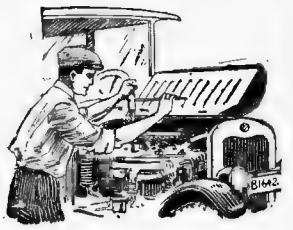


Motor Hints

Conducted by
GEORGE A. LUERS



Valuable pointers for the car owner assist in keeping the auto in condition

Simple Tests for Oils and Gasoline

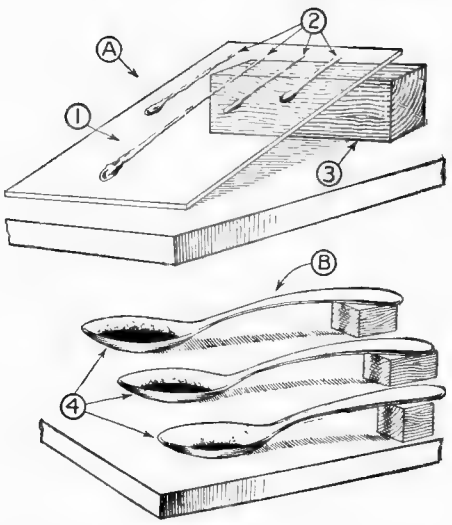
A SIMPLE test to determine, by comparison, the fluidity of various brands of engine oil, which tests can be made readily by the owner, consists in placing a drop of each oil on an inclined piece of glass.

The glass is located in a cold place, and a drop of each oil is placed near the upper edge. The oil which flows the farthest is obviously best suited to winter lubrication purposes in the automobile engine. Those oils which congeal and refuse to flow are better suited to hot weather operation.

In the use of gasoline, the most desired condition is that the gasoline will leave a minimum of soot to foul the plugs and increase the carbon.

A simple test of gasoline for the owner is that of filling several old teaspoons each with a separate grade of gasoline. They are lighted with a match and allowed to burn out. The gasoline which throws off the least soot and leaves the least deposit of soot in the spoon has the most desirable qualities for use in the engine.

While these are crude tests, nevertheless the owner will find them advantageous by reason of their simplicity.



Above—A, gravity test; 1, glass; 2, drops of oil; 3, block; B, gasoline test; 4, spoons.

DO YOU KNOW

Where a small accumulation of carbon in the engine causes a knocking, the simplest remedy is to use two cylinder head gaskets. No mechanical changes or additional work is required to adopt this repair.

Improving the Breather Pipe

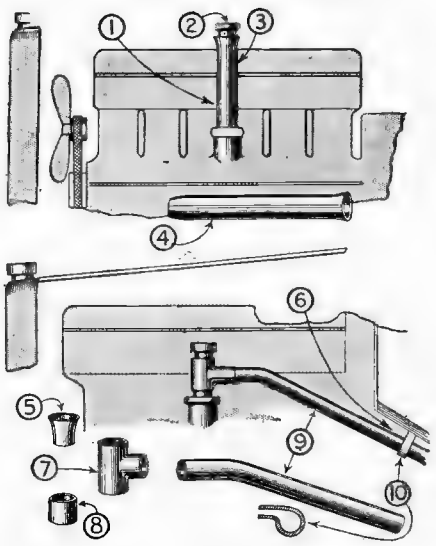
In the spring it is noticeable that much oily dirt has accumulated under the engine hood. This is especially true where the cold weather has interfered with the frequent cleaning off of the engine. Practically all of this is due to the oily fumes which escape from the engine breather pipe, which is carried rearward by the fan to deposit on the cylinders and on adjacent parts. This collects the dust and dirt.

A simple method used by one owner is shown in the upper part of the attached sketch. A sheet iron extension was made, fitted into the filler opening and carried up above the top of the engine. The cap was fitted into this extension.

A more commendable but more extensive fitting was arranged by another owner, as shown in the lower section of the sketch. This was made by fitting a sheet metal tube into a pipe tee, arranging the covering cap above this and from the horizontal part of the tee, carrying a metal tube rearward and down under the floor boards.

By means of this, all oily vapor, fumes and dirt is kept out of the area under the hood.

These methods are easily adopted and well worth the consideration of the careful owner.



Above—1, elevating the breather pipe; 2, cap; 3, metal extension; 4, the metal tubing; 5, fitting for cap; 6, gases exhaust under car floor; 7, pipe tee; 8, section to fit breather opening; 9, sheet iron tube; 10, clip.

Straightening Axles

When the car skids badly on the slippery pavement during those difficult driving days of winter, the front or rear wheel comes up suddenly against a curb. The result is a sprung rear axle shaft or a damaged front wheel spindle.

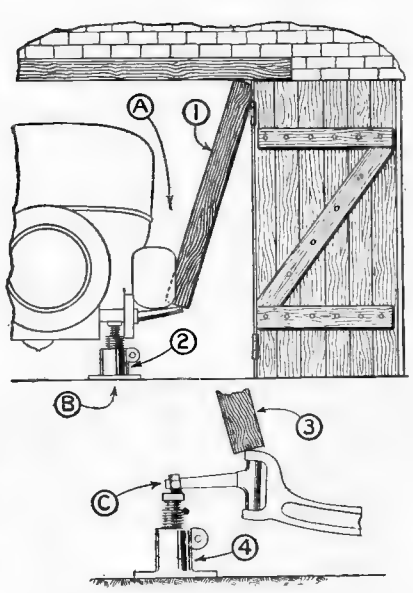
One of the methods available to the individual car owner for straightening out the bend is that shown in the attached sketch.

Place the car in the door of a brick building in the position shown to bring the sprung axle in line with the bricked-in opening.

After revolving the axle, in the case of a rear wheel bend, so the upper part is the high section, block with a four by four or a two by four. Use a heavy car jack under the axle and lift this until the axle springs back.

In the instance of a front spindle bend, place the prop either on the outside end or above the spindle joint, depending upon whether it is bent up or down. The jack is placed on the opposite end.

Under no circumstances drive with a sprung axle. The bearings will quickly break down, apart from the tire damage that results.



In the above illustration, A shows a method of straightening a sprung rear axle; B, view of work facing entrance of garage; 1, wood beam; 2, jack; C, straightening sprung front wheel spindle; 3, wooden support, and 4, jack.

Quick Removal of Cotter Pins

The time for adjustments, replacements of bushings, removal of lost motion in bearings and other repair work on the car depends upon the facility with which nuts and bolts can be removed.

Obstinate cotter pins cause much delay, especially when cotter pins are in awkward places such as in the crankcase of the engine.

(*Cont. on page* 1212)

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A ONE-MAN SUBMARINE

"Taxi-Sub" May Be New Under-Sea Terror---Has a Cruising Range of Five Hours

By FREDERICK C. JONES

THE "taxi-sub" opens up an entirely new phase of naval warfare, for many factors lacking in the larger submarine have been added to the "taxi-sub." The points in its favor being: low cost of construction, unlimited cruising range, a smaller target, less vulnerability, and absolute safety to the operator.

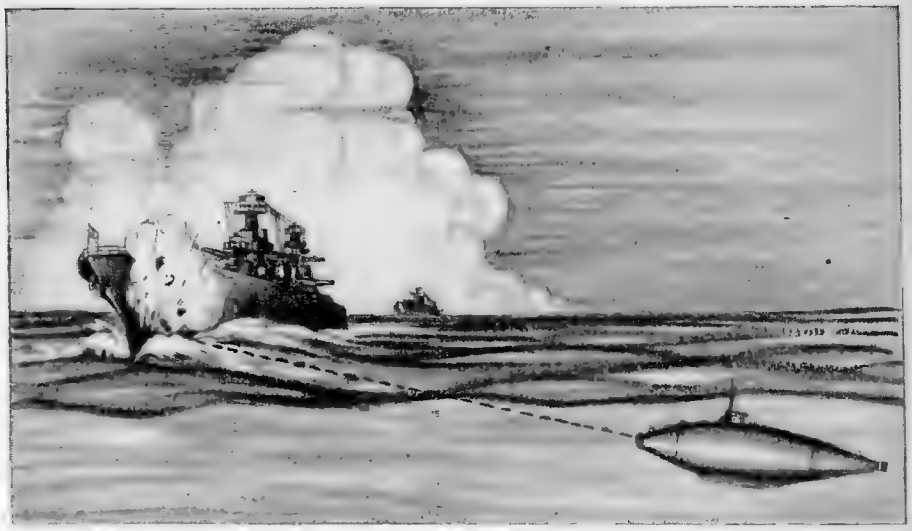
Disadvantages of Present-Day Submarines

THE risks attendant on the old type of submarine renders it sometimes difficult to secure a highly satisfactory crew, and so far entirely reliable life-saving equipment is lacking. The submarine is large in structure and easy to hit, it cannot move about and be handled with the ease the commanders would like and the time taken to submerge and disappear is far too long. It is also a good target, for even when submerged its water disturbance betrays its presence, to say nothing of leaking oil and hydrophone equipment on enemy ships.

Except in a few rare instances, the cruising range of the submarine is limited to a few days from its base and very few can undertake a long voyage. This, coupled with the enormous cost of building, upkeep and payment of crew, still leaves much to be desired.

The "Taxi-Sub"

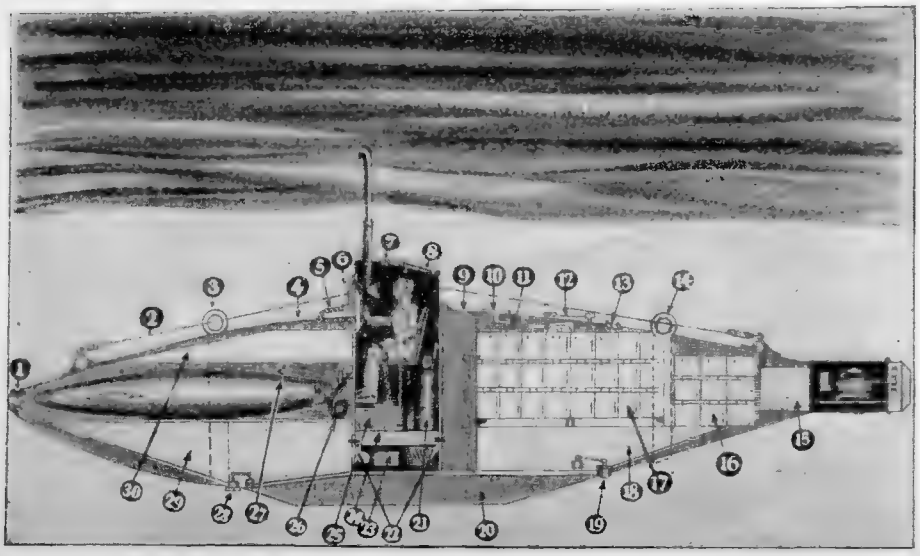
NOW with the "taxi-sub" none of these disabilities prevail, all former submarine difficulties have been studied and the inventor claims to have achieved as near perfection as practicable, with the one-man sub.



The small submarine will carry torpedoes and can creep close to a ship without being noticed. The above illustration shows a one-man submarine which has launched a torpedo at a battleship.

Above is the cabin or tapering cylinder released from the sub.

In the illustration below, 1 is the torpedo door; 2, the antenna; 3, lifting ring; 4, electric controls; 5, jack plug; 6, port; 7, vent; 8, door; 9, diaphragm; 10, electric controls; 11, manhole; 12, vent; 13, antenna; 14, lifting ring; 15, air tank; 16, emergency tank; 17, batteries; 18, ballast tank; 19, valve; 20, air tank; 21, emergency air tank; 22, release bolts; 23, buoy; 24, weight; 25, battery; 26, spring; 27, torpedo; 28, valve; 29, ballast tank, and 30, air tank.



This little craft measures 30 ft. in length with 5 ft. 6 in. beam and is 8 ft. high at its tallest part; this renders it extremely portable and two or more can be carried with ease on the average battle cruiser, and, being entirely operated by one man, a great saving in personnel is effected, thus leaving more men for other duties.

Cabin Release

THE great feature is the cabin release, which acts as a life-saver for the operator should his craft sink or be disabled. This release is operated by three different methods: by the hand lever, which is worked by the hand of the operator at his own will; next comes the "Deadman's Control," operated from the seat, should the man faint or become injured, for it is certain he could not remain on the seat which is just sufficient to rest upon, and as soon as his weight is removed, springs close the contacts and the cabin is released. Next is the diaphragm release. This operates at specified depths which can be set, so in the event of the craft getting below a safe working depth, the contacts close. Thus we have three methods of safety that cannot fail.

The cabin itself is a tapering cylinder which contains the operator, all switches, radio apparatus, and a compressed air tank. It is weighted to insure its floating in an erect position and has no connection with the main shell. All controls which are electric throughout pass through a large jack which plugs into the cabin after the operator is snugged down.

Position Buoy

BELOW the cabin is a small buoy and several hundred fathoms of cable, which, after the cabin is released, would float to the surface and indicate the position of the "taxi-sub" as she rests on the bottom. If she was in a safe working depth, divers would then salvage her or if in a greater depth she could be grappled, as lifting rings are fitted fore and aft; this would permit lifting the vessel bodily, which would be impossible with a larger vessel.

The release action consists of a double-

(*Continued on page* 1211)

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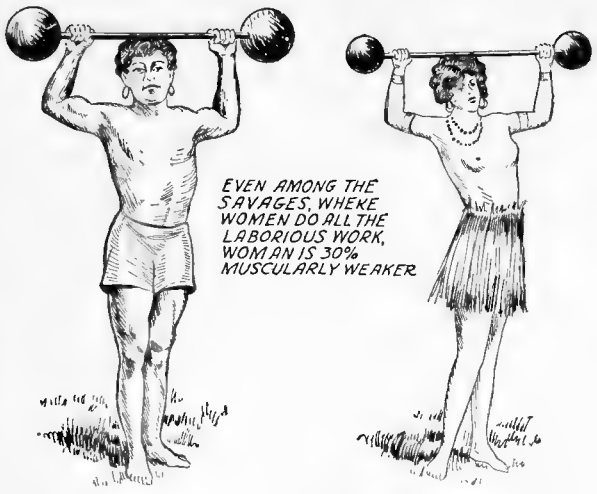

WOMAN *the* DOMINANT SEX

It has never been questioned that the average woman is inferior muscularly to the average man. This difference amounts to about 30%. This inferiority is not the result of any social disability, as it is found even among those savages where hard work is the lot of the female. This is a sex-linked disparity.

By
ROBERT KINGMAN
M.D., F.A.C.P.

SILK stockings and thin undies, or wool socks and heavy combinations? Which will win in the race for strength between the two sexes?

Medical men are putting their stamp of approval on the back-to-nature movement in underwear. Victory, they believe, will be to the sex that adopts a next-to-nothing policy, and not to the one that carries the heaviest protection against the weather.

At a convention of physicians it was recently stated that our American women are today in better physical condition than our men. One of the chief reasons for this state of affairs is the fact that women do not wear too many clothes, especially in summer. Because their garments are relatively light in weight and light in color, their bodies receive a far greater percentage of the ultra-violet rays of the sun than do those of the so-called stronger sex.

Men are almost completely covered from head to foot with darker clothing of heavier weight which insulates them from these healing and strengthening rays. There are other causes, as well, that are operating to bring about not merely physical equality between the sexes, but even, according to many authorities, physical superiority on the part of the women. Every day woman is demonstrating that her traditional inferiority in muscular endurance is a thing of the past. She plays tennis from sun-up to sun-down, she competes in long swims in icy water and she survives the trying conditions of continental flight without turning a hair.

Centuries ago man imposed his will on woman through sheer force of muscular strength. Until recently he has done his best to promote the idea that he was her superior in every way, mentally and physically. Now, however, that woman has the time and the energy to inquire more closely into the facts in the case, she has inaugurated a campaign to discourage the pretensions of her lord and master.

Is Woman Weaker?

S it true that woman has always been the weaker vessel?

What are the physiological facts? Here are some of them:

To commence with, woman lives longer than man, and while she lives, she is tougher. This is no accident of nature, but a wise provision for ensuring race preservation. An excess mortality of five or six millions of men during war, is of little moment to mankind in the long run. The sudden demise of a similar number of women, would be quite another matter and one which should give pause for thought to our friends in Russia and elsewhere, who are training and arming their womenfolk for use on an equality with men soldiers in the next "last" war.

Then, too, nature, recognizing that woman plays a far more important part in the business of reproduction than man, has made her better able to stand wear and tear.

Despite popular belief in her fragility, woman's physiological processes are less deleteriously affected by periods of intense strain than those of man. She has less difficulty in adjusting herself to privations and hardships, when these are inevitable. She contracts disease less readily than man, and is less detrimentally affected by exposure. While she needs on the average a little more sleep for maximum efficiency, she reacts more quickly and with less exhaustion to prolonged sleep deprivation than man. Her superiority in the matter of enduring pain and in rapidity of convalescence after shock and hemorrhage, are matters of common knowledge.

The rays of the Sun cast their beneficial rays upon women more than men. The reason is that women's garments are lighter in both weight and color.

In order to arrive at just results in making comparisons between the sexes, individuals must be chosen weight for weight and height for height; a precaution which, as we shall see farther on, serves also to explode that ancient bugaboo of sex difference in brain weight.

While it is well known that men engaged in certain occupations have a diminished life expectation as compared to that of the average woman, it is not generally realized that in a comparison of the two sexes as a whole, the female shows a decided superiority over the male in point of mortality and longevity.

At equal ages widows are more numerous than widowers. The average length of life of woman is a little longer than that of a man; and of ten centenarians, seven are women.

Man is Weak

THE feebler resisting power of man to death appears from the very beginning; that is, from the very moment when sex is determined, and consequently, before birth. There are more still-born children of the male than of the female sex; and, although the total number of male children born is greater than the number of female births, the subsequent mortality is greater. In England, for instance, in 1913, 104 boys were born to every 100 girls. During the two following months, 132 boys, and at the end of the year 125 males, died for every 100 females. The female sex thus predominates in its resistance to mortality at all ages.

That the superiority in endurance of women over men

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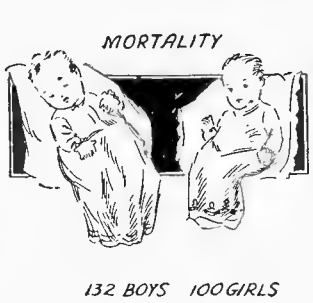
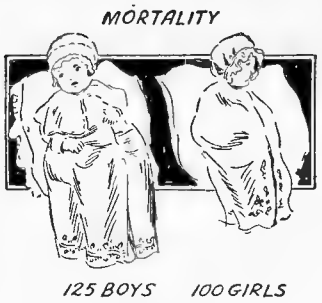
In England in 1913, 104 boys were born to every 100 girls. At the end of the first two months 132 boys died to every 100 girls, and by the end of the year, the ratio of deaths was 125 boys to 100 girls.

Birth



Two Months



One Year

betrays a definite purpose on the part of nature is strikingly borne out by tests on animals which show that under favorable conditions 100 males may be born to 100 females; but that the ratio may fall to 80 and even 60 against 100, when these favorable conditions are rendered unfavorable. The males, therefore, are decidedly more sensitive than the females to unfavorable alterations in conditions bearing on the struggle for existence.

The evidences of woman's inferiority so far enumerated depend upon the necessities of the reproductive function; they are readily admitted by man, and are, therefore, as a rule, no particular source of pleasure to woman. For woman is at all times peculiarly averse to any estimate of her value based on her importance as a factor in the art of creation. As far as equality is concerned, woman is more concerned when aspersions are cast upon her brain power than upon her brawn. In comparisons of the sexes she would like to be found superior, or at least equal, in a field in which she has no natural and admitted advantages.

Science, in the form of mental tests, does indeed, support her claim to an equality in the matter of intelligence. No significant differences in mental capacity have been found between schoolgirls and schoolboys, or even between adult men and adult women. Unfortunately, intelligence tests are applicable only to certain parts of the mental life: memory, imagination, comparison, judgment and in acuity of perception and fineness of discrimination of the sense organs. Other factors enter into the sum total of intelligence for which no reliable tests are as yet available.

Glands Make Achievement Possible

NO adequate tests of the dynamic aspect of mind—interest, persistence and particularly, energy—have as yet been devised. Intellectual abilities without motive power are as useless as a steam-engine without steam. The motive power behind the mind is energy, and energy is not generated in the brain itself, but is derived from accelerators in the shape of the internal secretions of the endocrine glands. Many a man of vast achievements and reputed genius owes his success merely to a surpassing energy motivating a mediocre brain.

Little is to be expected from a person finely gifted intellectually, if he be not also well equipped with energy-producing glands. It cannot be assumed that equal life achievements will result from equal mental abilities. The talents of the artist, without a driving force of ceaseless application, are of little use.

If it is true that woman's mental performances, as is sometimes asserted, are inferior to man's, there is good reason for believing that the disparity is dependent upon differences in glandular endowment, and consequently to the factors of energy and application, rather than upon any difference in the capacity of her brain cells or in the weight of the brain itself.

Ratio of Brains Alike in Male and Female

THE stock argument of the advocates of female inferiority has long been the gross anatomical difference in weight between the average male and female human brain. If a hundred male brains and a hundred female brains are selected at random and weighed, the average weight of the male brain will always be greater than that of the female.

There is also a constant discrepancy when the weight is compared age for age. Between the twentieth and the fortieth year the female brain averages 144 grams less in weight than the male brain; between forty and seventy, it is less by 154 grams; and from seventy to ninety years, there is an average difference of 164 grams. The difference obtains in infancy, increases during the growing period, and is maintained in old age.

This inequality, however, completely disappears when the figures are subjected to correction for body weight and stature. It then appears that the female brain weighs exactly the same in proportion to the weight and height of the body as the male brain. Weight for weight, and height for height, the woman's brain contains the same number of brain cells as a man's and weighs the same number of grams.

Women Muscularly Inferior

THAT woman is on the average inferior to man in muscular strength has never been questioned. The difference amounts to about 30 per cent. This inferiority cannot be referred to any form of social disability, for it is found among savages where hard labor is the lot of the female sex and among apes and all the other species of the mammalian class to which man belongs. The difference between the two sexes in muscular endowment is therefore an undeniably sex-linked disparity.

Actually, then, woman appears to be either the equal or the superior of man in all respects save energy and muscle. The disparity in energy depends upon dissimilar glandular endowment. The inferiority in muscle is in some way directly related to sex, and therefore in all probability is likewise dependent upon the internal secretions of the ductless glands.

Is it reasonable to suppose that such fundamental differences can be overcome and bred out? In the light of recent advances in our knowledge of sex determination, it is not only possible, but highly probable. Sex in chicks and tadpoles can be experimentally reversed at will; in the former by extrication of one-half the generative organs, and in the latter by subjecting the immature frogs to opposite extremes of temperature.

Experiments of this sort will certainly lead in time to prenatal determination of sex in human beings. Sooner or later, when boys are wanted, boys will come; and when girls are looked for, their names may be chosen without fear of a misfit.

Post-natal reversal of sex offers no difficulties even now. Extirpation of certain glands in (*Continued on page* 1178)

Woman is the superior of man from the standpoint of longevity and at equal ages, widows are more numerous than widowers. Out of every ten centenarians, seven are women. The feebler resisting power of man to death appears at the very beginning, or from birth.

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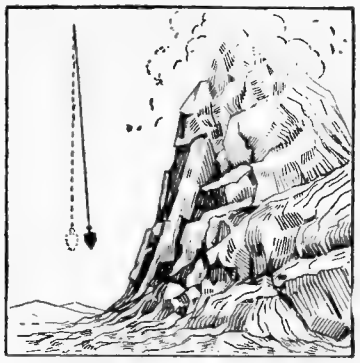
A minute of arc is equal to width of a man's face seen one mile away.

Vast Amount of Evidence Indicates That All the Lands Are Floating

Is the Land Afloat?

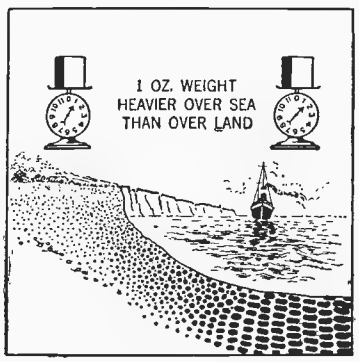
By E. T. BREWSTER



A small mountain mass has enough gravitation to attract a plumb bob.

MESSRS. AIRY and PRATT, heads of the British India Survey, back in the eighteen-fifties, found themselves in seven troubles. They knew the latitudes and longitudes of their stations, with an error of only a few yards. They had triangulated between them with an error of only a few feet. But the two methods failed to agree, sometimes not within half a mile. Moreover, there seemed to be no rhyme nor reason to the way the discrepancies fell out.

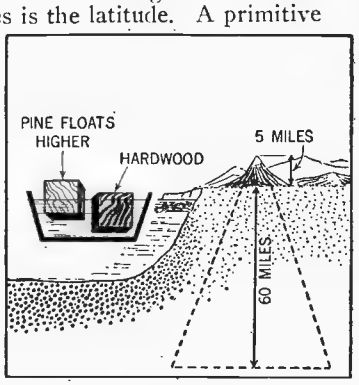
The trouble, apparently, was mostly in the latitudes.



An ounce weight is too heavy in some localities and too light in others.

Latitude is, of course, angular distance, measured in degrees, north or south of the earth's equator. But latitude cannot be measured directly, because while one can always see the place where he is, he cannot see the equator to measure from it. Neither can he see the pole, get the angle from that and subtract from ninety degrees.

The method, therefore, has to be indirect. One locates, by various devices, the point in the sky directly overhead. One locates the pole, close to the pole star. The angle between the two subtracted from ninety degrees is the latitude. A primitive method would be to hang a weight on a string, lie down under it, sight up at the zenith straight up along the string and take the angle between the zenith and the Pole Star. The sailor man really does the same thing when he "takes the sun." His sextant measures the angle between the sun and the horizon. But the horizon gives him a level ninety degrees from the direction of the plumb line. The position of the sun in degrees from the equator is given in the almanacs for every day in the year.



The reason why mountains are high can be illustrated as shown above.

A little arithmetic gives the latitude.

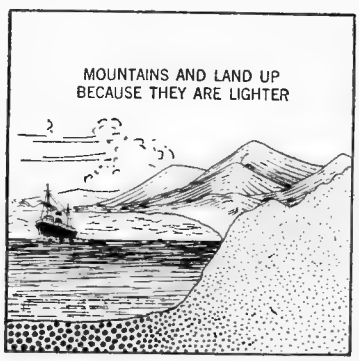
All latitude, therefore, hangs on the direction of the plumb line, found for the most part in practice by getting a level and taking ninety degrees from it.

It occurred to Messrs. Pratt and Airy that their trouble might be with their plumb line. They were on the great plain of India. North of them lay the vast mass of the Himalayan Range. Might it not be that the gravitation of this enormous body of earth was pulling the plumb bob northward, and so throwing the latitudes too far south? Or what is the same thing, were not all the level surfaces tilted up slightly on the north?

That proved to be the fact. But it took careful work to prove it; for a mile of distance corresponds to only a minute of arc—and a minute of arc is the width of a man's face seen a mile away. A geodetic survey works down to the sixtieth part of this small angle.

Later, toward the end of the last century, the same sort of facts appeared also in surveys of other regions—among them, those United States. It now appears that even a fairly small mountain mass has enough gravitation to pull a plumb bob toward it and make latitudes—and also longitudes—come wrong.

By that time, however, the same problem was being taken up by another method.



The reason why the continents are up in the air is because they are lighter than the ocean floors.

Everybody knows that what causes a clock to keep time is the pull of the earth on the swinging pendulum. Naturally, the harder the earth pulls, the faster the clock will run. Conversely, the faster the pendulum swings, the harder is the earth pulling on it. One has, then, only to time the swing of the same pendulum at different points on the earth, to find whatever local differences there are in the earth's gravity.

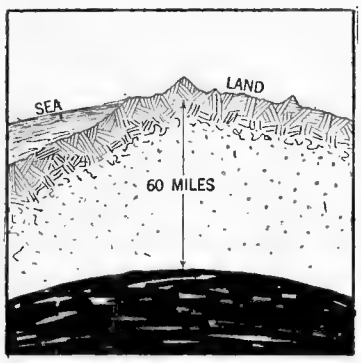
A vast amount of this sort of thing has been done—and with extraordinary accuracy.

What counts is the time of one swing. But if we time ten thousand swings with an error of less than a second for the whole series, the error for a single swing is very small indeed. So the pull of the earth's gravity is measured down to the thousandth part of one dyne. The dyne is a little more than the thirty-thousandth part of an ounce!

So we know the force of the earth's pull at some thousand different stations with an accuracy of the general order of the thirty-millionth of an ounce. As it turns out, what ought to be an ounce weight, at certain spots on the earth, is off by the three hundred-thousandth part of this not especially ponderous mass. From this as a maximum, the errors run down to nothing. But the ounce weight is too heavy in some localities, too light in others. Rarely is it just right. One needs to watch his grocer. Who wants to pay for a bag of sugar and find it a grain shy?

After this sort of thing had been done, with this extraordinary accuracy, at all sorts of places over the earth, certain most remarkable facts began to appear. *The same ounce weight is just the least bit heavier over the sea than over the land. The same ounce weight is just the least bit heavier over lowlands than over mountains.* Airy and Pratt had found the same thing in India in another form. The Himalayas pulled their plumb lines out of vertical—but not so much as should be expected from their size.

This can mean only one thing. The crust of the earth under the ocean is heavier, cubic mile against cubic mile, than the general run of the land. The lowlands are heavier, bulk for bulk, than the high country. (*Continued on page* 1210)



Sixty miles below the surface of the earth is a layer of basalt.

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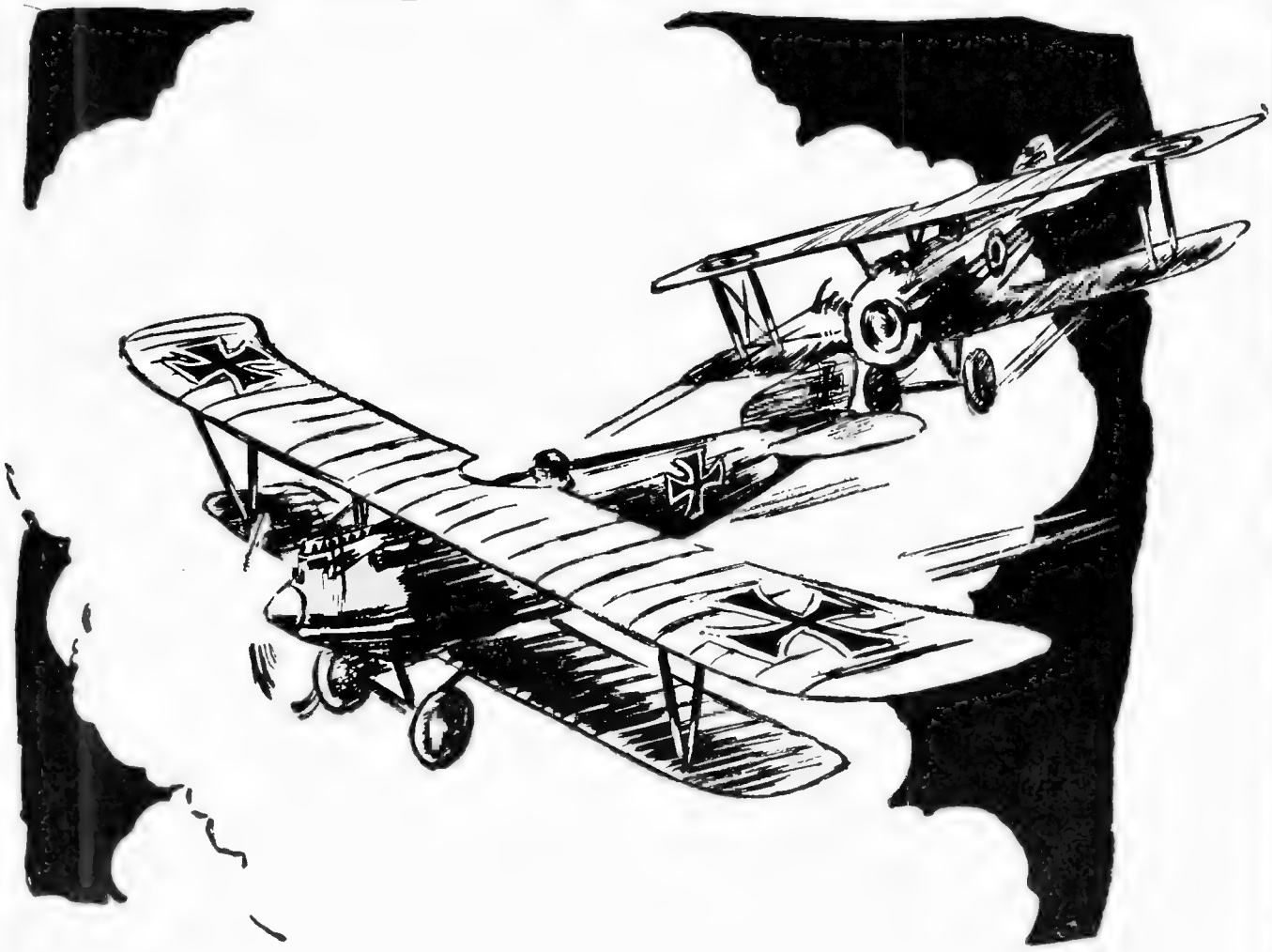

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The Suicide Air Patrol

By RAOUL WHITFIELD

In the APRIL

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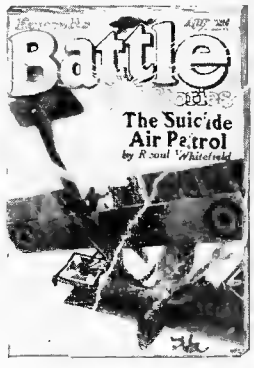
The popular magazine of thrilling war tales of the Army, Navy and Marines



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Editorial

"Those Who Refuse to Go Beyond Fact Rarely Get as Far as Fact" - - HUXLEY

ANT CIVILIZATION

By Hugo Gernsback

HUMAN beings, in their arrogance, frequently take the stand that there is nothing greater in the entire universe than human civilization.

It may appear fantastic to some of these good, but misled people that there actually are in existence civilizations far greater than that of which we boast to-day.

Anyone who has studied ant life, for any length of time, must have come to the conclusion that here we have to do with group intelligence of the most amazing, as well as highest, order. Human beings, despite their self-glorified civilization, are far behind ant civilization, for instance, in such things as government. In the ant State, everything is for the State, nothing for the individual. No matter what occurs in the ant State, it is always uniformly for one, and only one, purpose, and that is for the good of the State. Can as much be said for human civilization?

It is true that we have our sciences, our electricity, our astronomy, our medicine, our literature, and what not; and we advertise these things as a proof of our superiority. The ants, on the other hand, can get along without these things very nicely, and in the end are, perhaps, better off for not having them. There is even a chance that the human race, once it has progressed sufficiently, will be able to get along without these artifices as well.

As the human race becomes more enlightened, it begins to drop many unnecessary things that once were considered highly necessary. Once upon a time, it was a matter of life and death if you did not possess a club in order to ward off the wild animals, and in order to provide enough to eat by killing them. People nowadays do not run around with clubs any longer, because the advance of civilization found these implements of no further use.

On the other hand, the human being still finds it necessary to provide himself with an immense array of tools and implements in order to pursue his peaceful, as well as wartime, occupations. The ant, possessing a higher civilization, finds it possible to discard practically all tools and implements, and do as great an abundance of work as the human being does.

If you ask the average human being to build a concrete skyscraper, or to manufacture a first-class paper, he would scoff at the idea if you asked him to do so without tools of any kind. Yet, the ants build concrete skyscrapers, far greater in proportion to their size than human beings do, and all without tools of any kind. Thus the South American ants build an ant hill which often reaches the height of 25 feet. This, in proportion to the ant, is really a tremendous structure, because it is precisely 2,400 times greater than an ant standing up. In proportion to a human being, we would have to build a skyscraper at least two and a half miles high, a thing that no human being has ever attempted. Furthermore, the concrete used is as good, or better, in quality than we human beings have to-day, and what is far more important, it contains no steel frame, yet it has vast intercommunicating chambers, corridors, halls and what not, for the huge community, running into the hundreds of thousands of ants.

A certain species of ant make a very high class paper, which is real paper, by a process little understood by us, and without using any tools whatsoever.

There is hardly any of the peaceful pursuits that the human being lays claim to that the ant cannot do equally well. For instance, the agricultural ant grows a number of things, which are later regularly harvested; and among others, they grow a small variety of mushrooms in their underground caves.

They manufacture a very high grade of honey, which they store away, not in casks, but in the abdomens of their fellow workers. These abdomens become of such a tremendous size that they are sometimes twenty or thirty times the size of the ant itself, and the ant who thus is made to store the honey, becomes incapable of moving about and hangs head down from the ceiling in one position, through practically the rest of its life, for the good of the State.

As is well known, nearly every ant colony keeps its own cattle, and herd these cattle the same as we do. Certain plant lice, called *Aphids*, are regularly milked by the ants, who tend the cattle and keep them in captivity the same as we keep our cows. They even build fences and other enclosures to keep their cattle from straying away.

As for communication, our much vaunted radio and wireless are probably quite primitive when compared to ant communication. How the ants communicate with each other, and even over considerable distances, no one seems to know; but that they do communicate, no one can doubt who has observed ants for any length of time. Whatever the communication is, it is as rapid in peace time as well as in wartime. The message is instantly received and obeyed. What sort of waves are used by the ants we do not, as yet, know.

Mr. Hugo Gernsback speaks every Tuesday at 9.30 P. M. from Stations WRNY (297 meters) and W2XAL (30.91 meters) on various scientific subjects.

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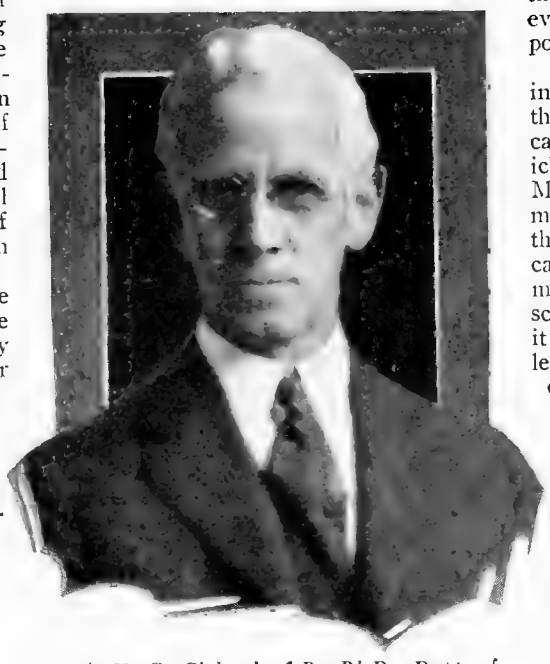
THE ORIGIN OF MAN

By PROF. HERDMAN F. CLELAND A.B., Ph.D.

Second of a Series of Articles on Evolution

IF it were not for the first chapter of Genesis and our instinctive feeling of superiority over other animals, the theory of evolution would have caused little stir in the religious world. But even this feeling of superiority is the result of evolution. It has caused tribes and peoples to enslave and kill alien peoples and by so doing has resulted in the survival of the more powerful. It is but one of the many qualities that has made man the master of the universe.

The scientist who can disprove the theory of evolution will stand out as one of the great men of his time, and many a man has begun a study of biology or geology with the hope that he might be that man, but every one has found the theory so strong that no intelligent person who has a knowledge of the facts of biology, geology, or botany, can fail to accept it. Most students of the subject now rightly hold that evolution is a fact, not a theory.



Prof. H. F. Cleland, A.B., Ph.D., Dept. of Geology, Williams College, Massachusetts.

IN the March issue of this magazine we presented the first article dealing with the evolution of man, written by Dr. Samuel C. Schmucker, Ph.D., Sc.D. The present article has been written by an eminent expert who treats the subject in a popular manner. The third article will appear in the May issue and has been prepared by Dr. Ales Hrdlicka, of the U. S. National Museum, at Washington, D. C.

Study of Fossils

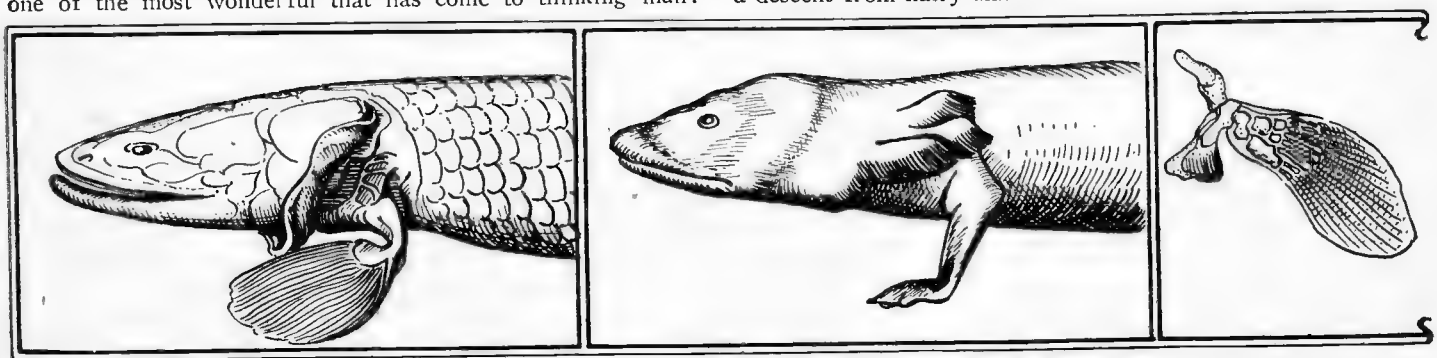
ONE of the most remarkable things, brought out by a study of fossils, is the fact that as one goes further and further back in time, animals of every kind become more and more simple. The present striking differences in the appearance of the horse, elephant, camel, and rhinoceros, for example, become less and less marked until such differences disappear, and the remote ancestors of these unlike animals were so nearly alike 50,000,000 years ago, that it is difficult or impossible to differentiate between them. If the record were more complete there is little reason to doubt that a common ancestor for all these diverse forms would be found. The American Museum's expedition to Mongolia has recently found the fossil skulls of several kinds of small mammals. Some of these not only combine the characteristics of later insect eaters (insectivores) but of primitive flesh eaters (carnivores) as well, and give us a picture of animals from which sprang such animals as the lion, the horse, the elephant, the camel, the swift deer, the stupid rhinoceros, the huge whale, the monkey, the ape, and man himself. Such a conception is one of the most wonderful that has come to thinking man: that all these diverse animals were slowly evolved from little, insignificant ancestors possessing no marked peculiarities.

It is natural that we should be more interested in the origin of man than in that of any other creature. Genealogical records have been the prized chronicles of almost every people and tribe. Man's body has been called a veritable museum of antiquities, and because of this we carry about with us a genealogical record, that goes back hundreds of millions of years. It is fortunate for science that this is true because it makes it possible from a study of the body to learn a great deal about our remote ancestors. Although satisfying our intellectual curiosity, it is not so fortunate for our health, since some of our useless organs and structures cause disease and even death.

Human Embryo

IN one stage in the development of the human embryo the tail is longer than the legs and there are muscles for moving it. Some of these muscles disappear and others are developed to support and control other organs. The tails of animals are put to two uses, the free or external part is for many purposes, but the root of the tail is always associated with the viscera and to it the end of the intestine (rectum) is attached. An external tail has disappeared from the body of man and the apes, but a short tail composed of three or four vertebrae (the coccyx), is of great importance as it, with the hip bones, forms a sort of basket to hold the viscera. Why this should be, is evident on the assumption that man's upright position was gradually acquired. Moreover, the muscles of the hips, which act on the tail, had to bear the steady burden of the abdominal viscera. This they could not do and move the tail. Thus it is clear why man and the apes are tailless.

Again, in the six months human embryo the entire body, with the exception of the palms of the hands and the soles of the feet is thickly covered with somewhat long, dark hair. As the hair is shed before birth, its only purpose seems to be to prove a descent from hairy animals.



The figure above shows how, theoretically, the fin of some of the ancient Devonian lobe-finned fishes changed into a foot.

This shows the next stage in the progress toward man. For the first time legs appear. The animals (amphibians) breathed by gills early in life, but by lungs before maturity.

Above is the skeleton of the fin of the fish shown at extreme left.

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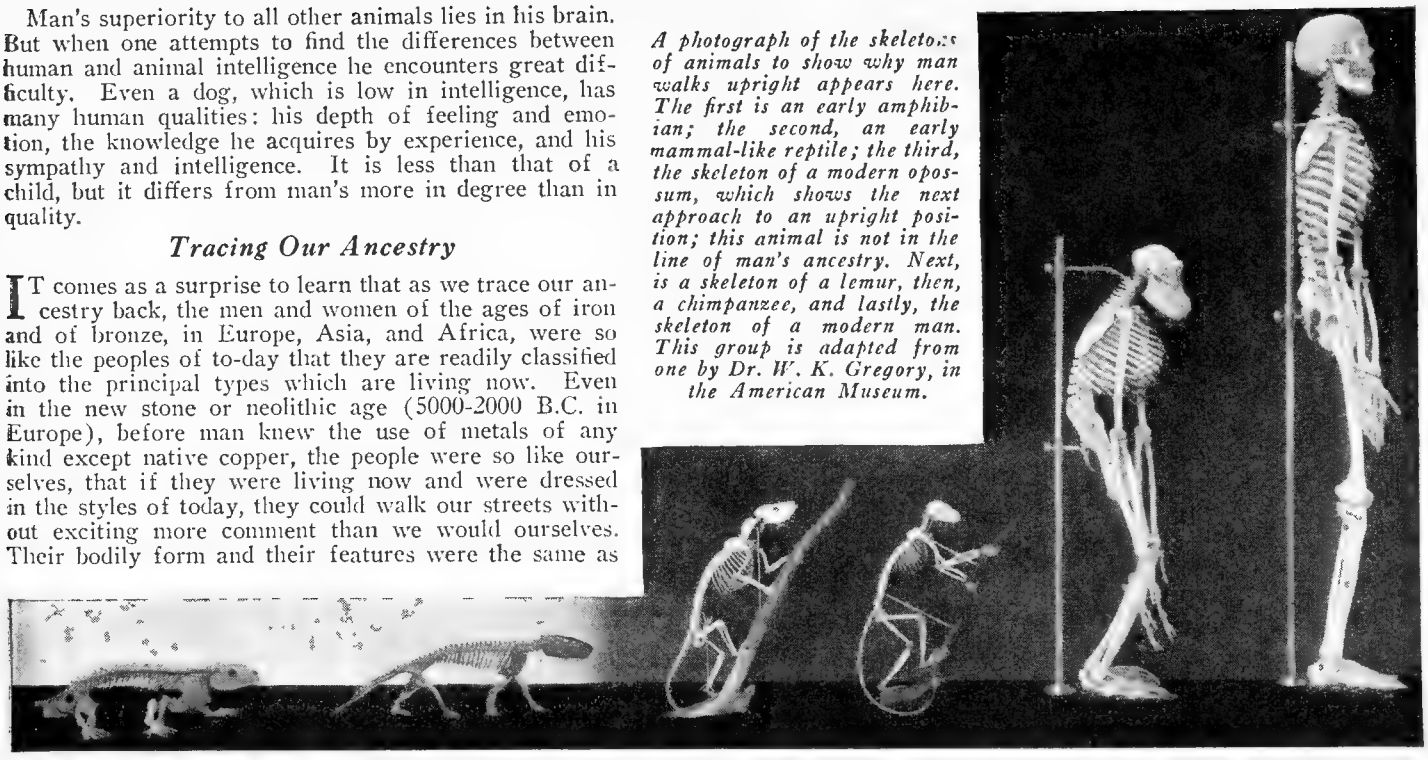
Man's superiority to all other animals lies in his brain. But when one attempts to find the differences between human and animal intelligence he encounters great difficulty. Even a dog, which is low in intelligence, has many human qualities: his depth of feeling and emotion, the knowledge he acquires by experience, and his sympathy and intelligence. It is less than that of a child, but it differs from man's more in degree than in quality.

Tracing Our Ancestry

IT comes as a surprise to learn that as we trace our ancestry back, the men and women of the ages of iron and of bronze, in Europe, Asia, and Africa, were so like the peoples of to-day that they are readily classified into the principal types which are living now. Even in the new stone or neolithic age (5000-2000 B.C. in Europe), before man knew the use of metals of any kind except native copper, the people were so like ourselves, that if they were living now and were dressed in the styles of today, they could walk our streets without exciting more comment than we would ourselves. Their bodily form and their features were the same as now; some were good to look at, some were homely, some were tall, and some were short. Moreover, the people of the new stone age were probably as intelligent as the people of today. They had made the great fundamental inventions: agriculture, domestication of animals, weaving, pottery, house-building. How long would it take our descendants to make these discoveries if the babies of the world of to-day grew up in ignorance and had to rediscover them?



A photograph of the skeletons of animals to show why man walks upright appears here. The first is an early amphibian; the second, an early mammal-like reptile; the third, the skeleton of a modern opossum, which shows the next approach to an upright position; this animal is not in the line of man's ancestry. Next, is a skeleton of a lemur, then, a chimpanzee, and lastly, the skeleton of a modern man. This group is adapted from one by Dr. W. K. Gregory, in the American Museum.

When we go back still further—to the old stone age, paleolithic—when man had not yet even learned to grind his stone tools, and knew nothing of agriculture, the domestication of animals and all the inventions which accompany these, we find the same species as our own, *Homo sapiens*. These people, Cro-Magnon, Predmost, and others, were hunters, but some of them developed a realistic cave-art that is the delight and wonder of artists. Not a great many skeletons of these people have been found, but those that are known show that the race was highly intelligent. The best evidence at present indicates that these people entered Europe from Africa and Asia not more than about 14,000 years ago. Men and women of our type have lived in Europe for at least 14,000 years and in Asia and North Africa somewhat longer.

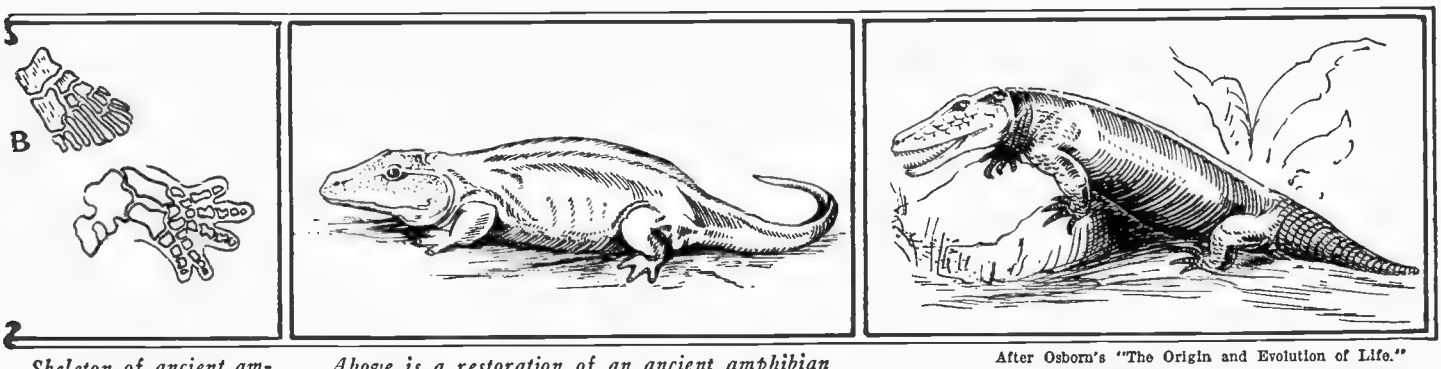
Neanderthal Men

BEFORE people of our kind inhabited Europe, that continent was sparsely populated, as was Asia and Africa, by men of quite different aspect. These are called the Neanderthal peoples. The Neanderthal men were small—about five feet four inches tall—with heads larger in proportion to the size of the body than ours. Their sloping shoulders were stooped and their thick, bull necks were bent forward in the same curvature as the back, that is, in an ape-like posture. Their legs were stout and bent at the knees and hips, giving them a shuffling, awkward gait. The general impression was of a creature of low intelligence, notwithstanding the large brain, and of great physical strength. A shaggy covering of hair which probably covered the body increased the brutish appearance. The great size of the brain, which exceeds that of modern Europeans, was due to a great development of that region which was probably concerned primarily with the mere recording of the fruits of experience, rather than with the acquisition of great skill in the use of the hand and the attainment of the sort of knowledge that comes from manual experiment.

If one may assume that the peculiar flint implements with which some of the skeletons of this race are associated in every case were made by these people and by no others, the Neanderthalers ranged widely: from Mongolia to India and Mesopotamia, and over a large part of Africa and Europe. Most anatomists think that the Neanderthal race is not in the direct line of our ancestry, but was one of a number of species of man that for a time was successful, but was eventually crowded out by the more capable type to which we belong.

Piltdown Man

AS we go further back in time, the evidence becomes more and more fragmentary. A jaw deeply buried in gravels at Heidelberg, Germany; a broken skull and lower jaw from gravels in Eastern England, at Piltdown, are different from any others known. The Heidelberg jaw is very heavy, and has no chin, in this respect differing from that of modern man. But the canine or dog teeth are no longer than the other teeth of the jaw and do not fulfill our conception of a bestial creature. The Piltdown skull, which has been called the "Dawn Man," is very thick but the jaw (if it (*Continued on next page*)



Skeleton of ancient amphibian's foot; and of lobe-finned fish's fin at B, for comparison.

Above is a restoration of an ancient amphibian (Eryops). It is so poorly constructed that the body is not raised above the ground.

After Osborn's "The Origin and Evolution of Life."

In the next stage we find an animal (Seymoria) that had lungs when born and which could raise its body from the ground and run swiftly.

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The Origin of Man

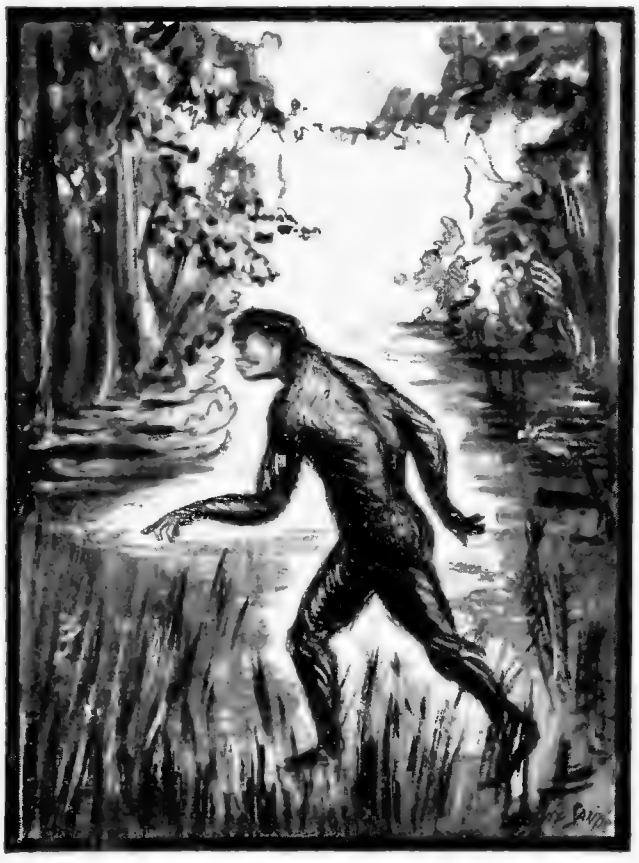
By Prof. H. F. Cleland, A.B., Ph.D.

(*Continued from page* 1129)

belongs to the skull) is light and does not have a chin.

"Ape Man"

STILL earlier is the so-called "Ape Man," or



Prof. W. D. Matthew's restoration of the famous Ape-man which, though it may not be directly ancestral to man, is of great interest as it is the earliest man-like creature known.

Pithecanthropus erectus, portions of the skeleton of which were found in Java, associated with the bones of extinct animals which date the deposits as Pliocene, an epoch in the earth's history which closed more than a million years ago.

A recent writer (Prof. W. D. Matthew in *Natural History,* Nov.-Dec., 1928) describes these creatures as tall, upright and broad-shouldered. The prominent eyebrows formed a heavy dark shelf shadowing the deep-set eyes and the projecting muzzle was nearly as heavy as in a gorilla. The set of the head on the shoulders, too, was quite ape-like. Mentally, Pithecanthropus was a boy in the forest, not a monkey, though he had the monkey's superior interest in fruits and relative indifference to small animals. His size, equalling that of a tall man, played an important part.

It is evident from the foregoing description of Pithecanthropus—the Ape Man—that we have here an ancient manlike animal of great interest, not only because it has a close resemblance to man himself, and because it is the earliest distinctly manlike creature of which there is any record, but because it shows us something of what our early ancestors were like. Few authorities will claim that it was a direct ancestor, but all hold that it was very much like it.

Back further in time, during the millions of years of the Tertiary, there lived apes and apelike creatures, some of which have characteristics that point to a close relationship to man's ancestors. Their fossils are rare for the reason that, living in trees and on the drier lands, man's ancestors and relations had little chance of being buried in the sands and muds of the seas in which their remains would best be preserved.

The oldest fossil ape (Propliopithecus) is an animal smaller than a gibbon (the smallest of the living apes). It was found in deposits in the deserts of Egypt belonging to a period probably 20,000,000 or 30,000,000 years old. It has a short jaw and small canine or dog teeth. A comparison of this little lower jaw and that of a man, shows that by a slight reduction in the length of the canine teeth and a slight change in the grinding teeth, the two jaws would be similar. But if the canine teeth were enlarged and the jaw lengthened, the jaw would be like that of modern apes. This fact has led an eminent authority to place this creature as a close relation of the common ancestor of the apes and man. Later, other apelike animals appear from which the gorillas, chimpanzees, gibbons, and orangs were descended.

Still further back in time (Eocene—40,000,000 or 50,000,000 years ago), many kinds of small, monkeylike creatures lived. All of them, as far as the fossils discovered show, were related to the lemurs, those little, simply constructed creatures now surviving on the tropical Island of Madagascar. In their anatomical features and in their intelligence, lemurs rank below the monkey. These little creatures, with their foxlike faces and soft fur, feed on fruit, insects, reptiles, and small birds. In many ways, they are intermediate between the apes and monkeys on the one hand and the lower mammals, such as the insectivora, on the other. There is little doubt that the common ancestor of man, the monkeys, and the apes, was something like the little lemur of Madagascar.

Our Remote Ancestors

THAT man's remote ancestors lived in trees is evident to anyone who has a knowledge of human anatomy and the skill to interpret what he sees. As a result of life in the trees, the forefoot became a hand, the hind foot became developed not only for support but for grasping branches with the thumb and fingers in climbing. Because of this, one hand could be used to pick fruit and carry it to the mouth while the other was holding on to a branch. With one hand or both hands, the young could be held close to the mother and be warmed and sheltered. Man, therefore, owes his hand to this stage in his evolution.

The free movement of the arms and the mobile hands made unnecessary the strong grasping teeth and the protruding jaw such as other animals have, and gradually the face shortened, and the teeth became more crowded. By the shortening of the lower part of the face, the eyes were brought relatively further to the front. In the meantime, the brain gradually became larger. The ability to turn the head from side to side, so important in locating sounds and in seeing, came from tree-life. It also led to man's upright position, by increasing the freedom of movement of the thigh and by making a flexible but strong backbone, and by developing a strong collarbone and shoulder girdle. The sense of touch became highly developed, but the sense of smell seems to have become less keen.

If man's remote ancestors lived in trees, why did they leave the trees? Leaving the trees would not only put them at the mercy of wild beasts but it would necessitate abandoning the food they liked and upon which they depended: fruit, insects, birds' eggs, and young birds. It is evident that this revolutionary change was not one of choice, but that these arboreal ancestors of ours were forced by external conditions to give up life in the trees and live upon the ground.

Why Dawn Men Survived

IF they inhabited a region where a warm, moist climate was becoming progressively drier, they would be forced to adopt new habits. As the prairies widened and the forests diminished and with them the fruit, nuts and birds, the death rate of these ancestors of ours must have risen, and destruction must have sought out unsparingly all those least able for any reason to meet the new conditions. In places, the rising death rate must have led to total extinction; elsewhere, death spared a few, but these, by the elimination of their non-progressive fellows, became new creatures. These "Dawn Men" survived not because of their physical strength, not because of any protecting covering, but for two reasons. Because of their greater brains, they were more crafty and clever than their competitors, and because, on account of the peculiarity of their limbs, body, sight, and brain, which were acquired during hundreds of thousands of years of tree life, they could occupy a place in nature where competition was somewhat less keen.

Man and Apes Have Common Ancestor

IT should be kept in mind, in this connection, that man was not descended from any genus of living apes, but that, if the record were complete, it would be possible to trace the apes and man back to a common ancestor. A striking example of the similarity of the brain of apes and man which shows the close relationship of the two is seen in the following inci-

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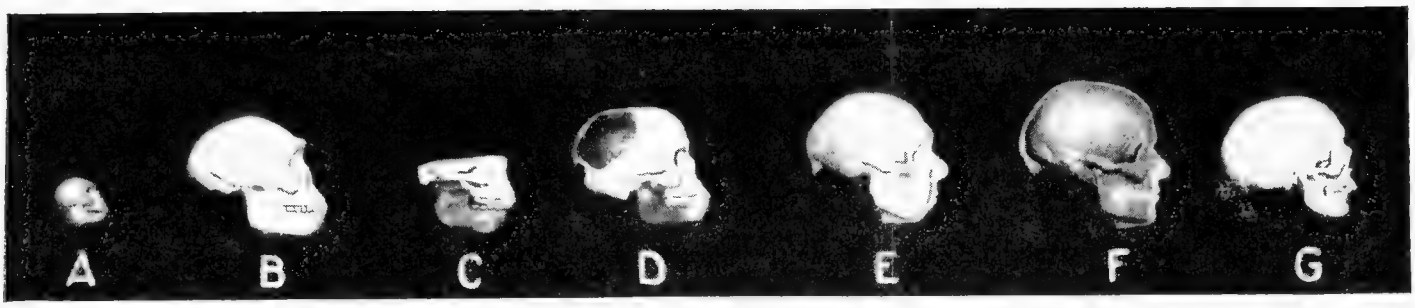

The skulls of (A) Propliopithecus, restored, (a close ancestor of both man and apes); (B) Pithecanthropus, or the Ape-man, restored; (C) Heidelberg jaw with the upper jaw restored. (D) Piltdown skull, restored; (E) Neanderthal woman's skull, restored with fleshy parts indicated; (F) Cro-Magnon skull, restored, with fleshy parts indicated; (G) modern man.

dent. At a football game a player was rendered unconscious during a play but the only external evidence of an injury was a bruise over one of his eyebrows. After a time, it was noticed that certain muscles were paralyzed. The brain centers which controlled these muscles were known from experimentation on apes. From the knowledge thus acquired, a portion of the skull was removed over that part of the brain which in the ape controlled these muscles. A clot of blood which was pressing on this center was removed and the patient made a rapid recovery. The location of the brain centers in both ape and man are nearly identical.

The descent of man and apes from a common ancestor is no longer a theory but a fact. Anti-Evolution Laws such as those of Tennessee and Arkansas need not worry us.

It is difficult to trace the ancestry of man beyond the Age of Mammals. There are many reasons for this. In the first place, only a few of the many kinds of animals that lived in these remote periods are known, and of these, only a few fragmentary specimens have been discovered. Another serious difficulty lies in the fact that the animals of 80,000,000 and more years ago—as one could theoretically prophesy—are the common ancestors of modern animals that bear little resemblance to one another. Notwithstanding such obstacles, it is possible, approximately at least, to trace our line back a half billion of years.

The ancestor earlier than the lemuroids was probably a little creature intermediate between the lemurs and the tree shrews. Earlier still it was an egg-laying mammal. Yet earlier it was an animal intermediate between lizards (reptiles) and mammals. From these mammal-like reptiles or reptile-like mammals we inherit our five fingers and toes and the number of joints in our fingers and toes. From them, too, we inherit a skeleton which can raise the body from the ground and which makes swift running possible. Besides these essential features, we inherit from them our three kinds of teeth, a better jaw, and other characteristics.

Above is a restoration of the Neanderthal man after Prof. Osborn.

Mammal- and Amphibian-Like Reptiles

THESE mammal-like reptiles were in turn descended from amphibian-like reptiles, and these from creatures which laid their eggs in the water and which spent the earlier part of their lives in the water and obtained their oxygen by means of gills instead of lungs. (The frog and toad of today pass through this stage.) These amphibians, as they are called, were sluggish creatures which dragged their bellies over the mud because their sprawling legs were not so constructed as to enable them to habitually raise the body from the ground. To these unattractive animals we owe our ability to breathe air.

These amphibians of a quarter billion years ago, who lived when the great coal fields of Pennsylvania, West Virginia, and Illinois were being made, were descended from fishes. The shark-like fishes of a billion years ago, as Dr. W. K. Gregory points out, already possessed the same ground plan of brain and spinal cord, the same type of segmentation of the spinal column, the same general type of complex skull. Moreover, these ancient fishes and their modern representatives agree with the early stages of the human foetus in the general plan of the jaws and gill arches, and in the basic features of the digestive, circulatory, respiratory, and reproductive systems. Hence the humble dog-fish or shark, which is a relatively little modified survivor of the early vertebrates, has a true ground plan of human anatomy and physiology.

Man's ancestry will some day be traced further back, but with our present imperfect knowledge of the earliest life of the earth, so much is conjectural that it will not be possible to discuss it here.

Those interested in genealogy, therefore, must begin their known family history with the fishes. From these, as we have seen, the line passes through amphibians, reptiles, mammal-like reptiles which became more and more mammal-like, through primitive mammals, through shrew-like lemurs, lemuroids, ape-like creatures, man-apes, and primitive man. This line of descent has been so carefully traced that it can be accepted as being correct in its essential features. Many of the details will doubtless be found incorrect as more fossils are available for study, but these modifications will probably not affect the broad outlines of the descent of man as given here.

Our Future

WHAT will be the future of the human race after these hundreds of millions of years of progress? The answer to this question would seem to depend upon man's ability in the future to master his environment. The following is the picture that Prof. A. P. Coleman paints: "It may be that the races of civilized men are merely evanescent phenomena bound up with the bracing climates of a brief Ice Age, to sink after a few more thousands of years, into a state of tropical sloth and barbarism when the world shall have fallen back into its usual relaxing warmth and moisture, the East African conditions, which have been so customary in the past."

If man continues to make inventions which enable him more and more to determine what his environment shall be, is it not entirely possible that he, in the near future, will be able so to regulate the temperature of his (*Continued on page* 1204)

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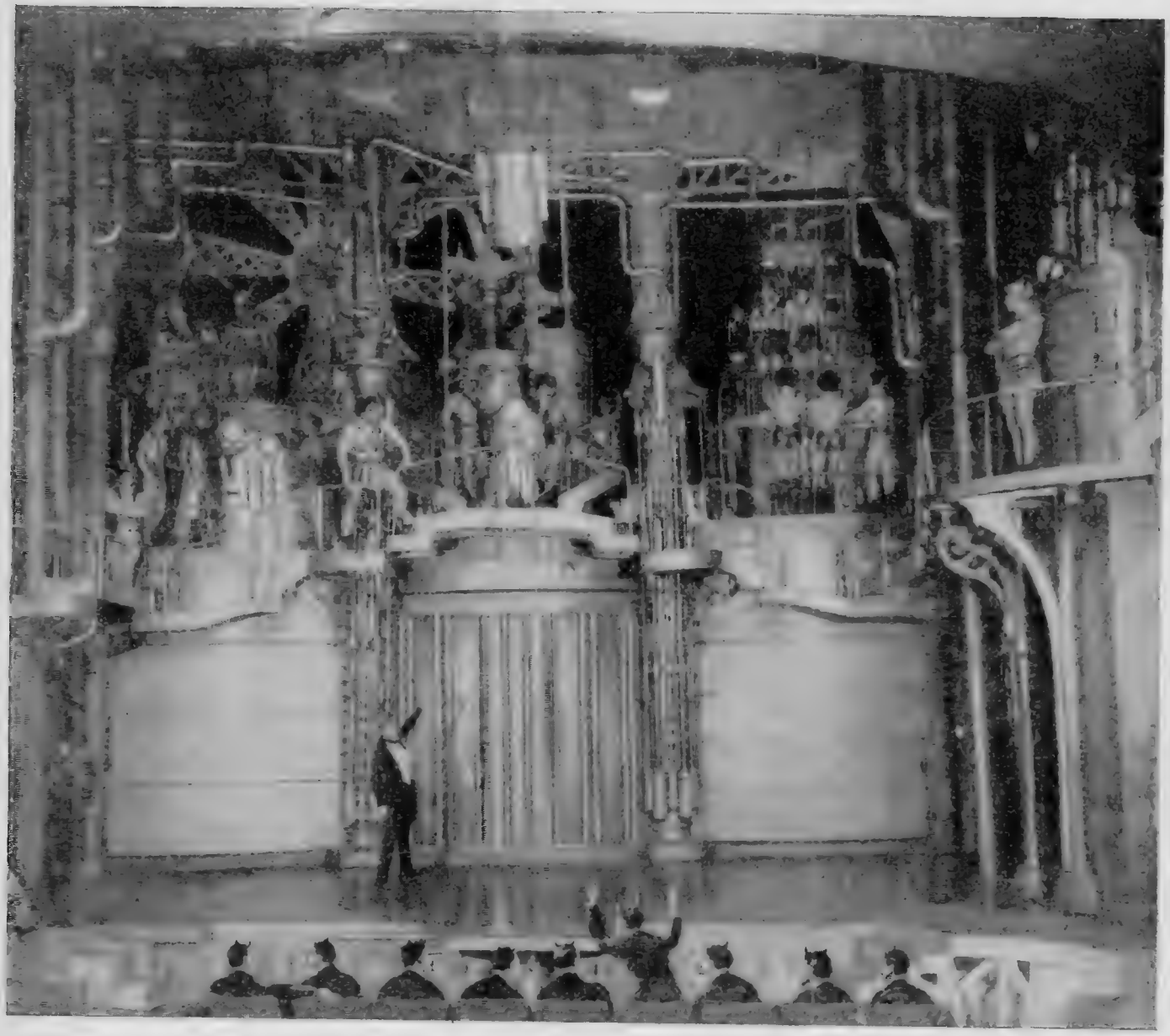
"MIMA"---A Masterpiece of

By H. WINFIELD SECOR

Super-Stage Spectacle Produced by Mr. David Belasco for New York Presentation Costs $350,000. Electricity Plus Mechanics Makes Scenes Possible.



Here we see an unusual photograph of the great New York stage production "Mima"—the remarkable engine here shown being supposedly the conception of "Magister," super-scientist of Hades. With this monster machine, known as a "psycho-corrupter," "Magister" guarantees to transform the purest soul into complete fiendishness in the space of one hour. The machine is later destroyed.

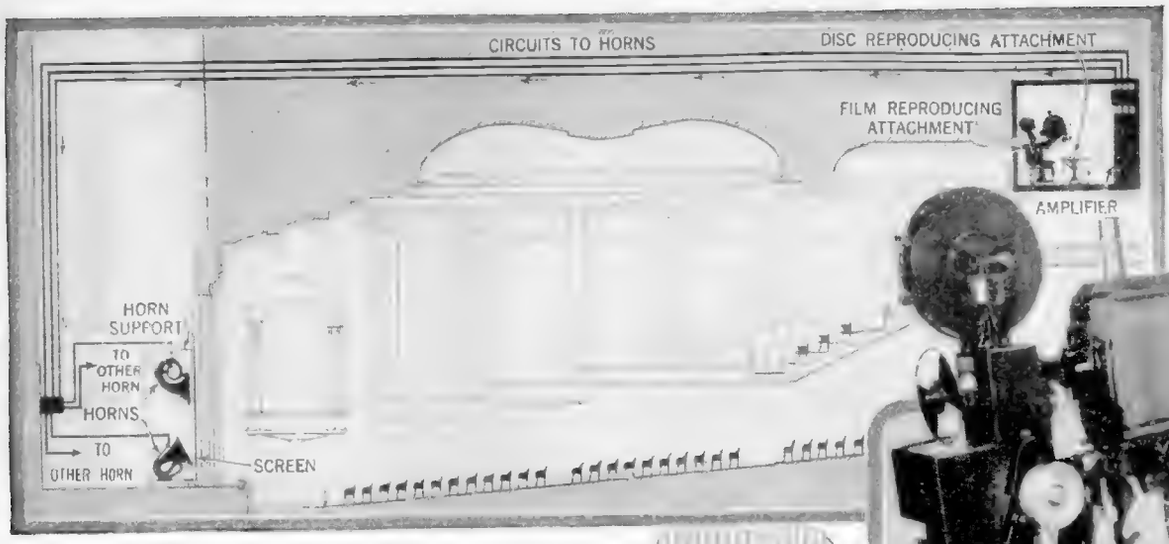
HADES, in all its theaterized fury, is staged at every performance of *Mima*, the great dramatic spectacle now appearing at the Belasco Theatre in New York City. It would seem to the author, and the artist who accompanied him back stage, to witness a recent production of this super-stage spectacle, that almost the limit had been reached both from the financial point of view, and that of stage technique. One who has not seen Mima can have but a faint idea of the beautiful and enthralling combination of the arts of the electrician, the painter and the illumination expert, that has been achieved in this, the latest and without a doubt, the greatest production of that genius of the American stage, Mr. David Belasco.

First make a study of the illustrations, and then stop to think for a moment that instead of gazing upon a huge engine, most of the cylinders, levers and rods of which might have been painted on wood or canvas in the old school style, but which are in this case actually constructed in a massive fashion, out of wood and iron, and you will begin to have some idea of the masterpiece that has been wrought upon the stage in this instance.

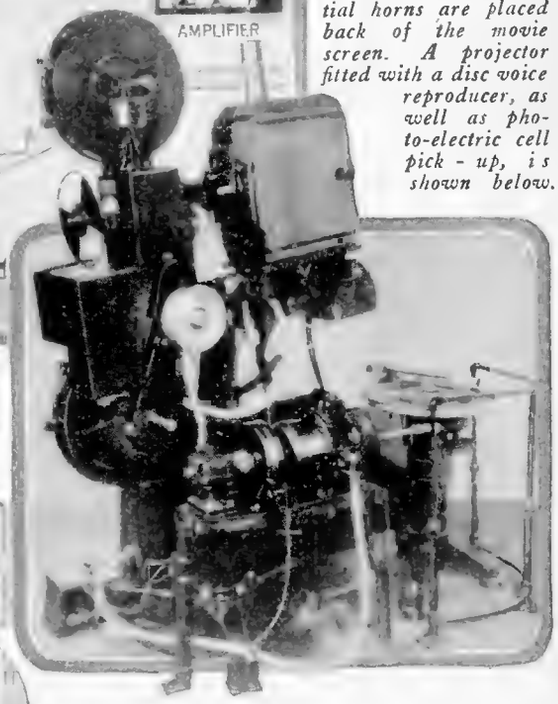
Engine Had to be Collapsible

BUT after the draftsmen, engineers and stage carpenters had arrived at the point where they were ready to construct this huge 40 foot high engine, there was still a greater problem to be solved; for in the latter part of this show, the engine is destroyed, and to accomplish this effect in a realistic and spectacular manner, the designers of the now famous engine scene, were called upon to arrange most of their cylinders, connecting rods, ladders and galleries so as to be collapsible, in order that when the cue was given, Magister's "psycho-corrupter" could be quickly transformed from a huge working engine, with revolving fly-wheels and reciprocating pistons, into a gigantic mass of twisted steel plates and railings.

The moment the galleries, ladders and other parts are permitted to collapse, by releasing the cables which suspend them from above, there is a tremendous roar of sound effects pro-

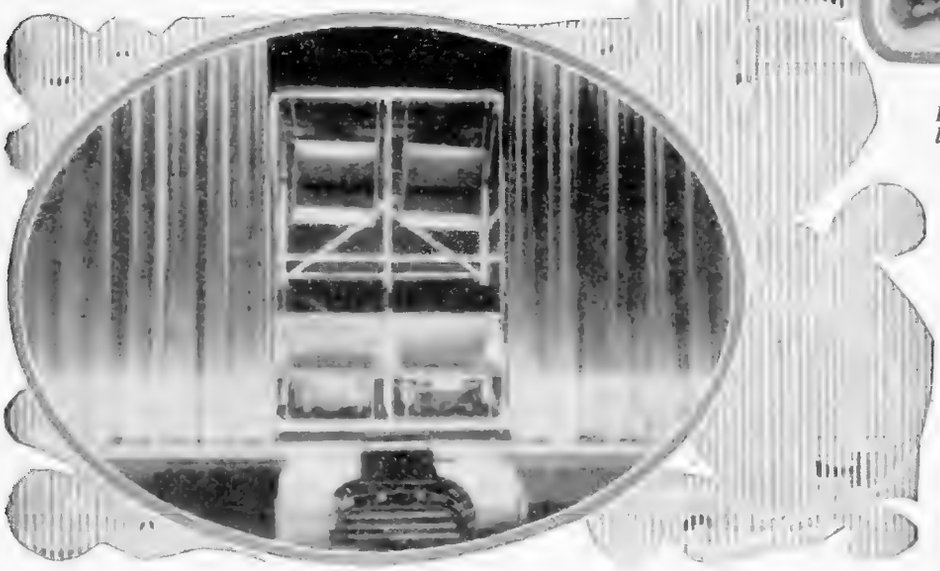


The section of a modern movie theatre at left shows the loud speaker circuits from the vacuum tube amplifier in the projector booth. Four exponential horns are placed back of the movie screen. A projector fitted with a disc voice reproducer, as well as photo-electric cell pick-up, is shown below.



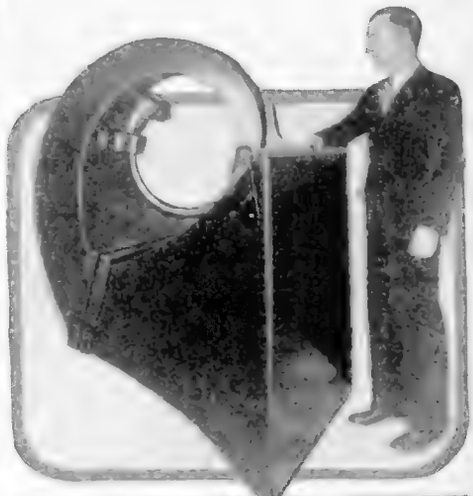
Movies "Talk"

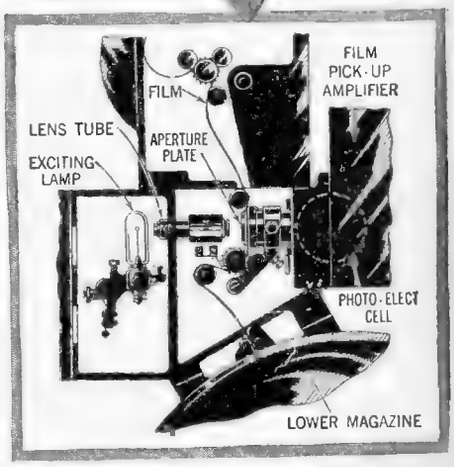
and Reproduction of the Talking Motion in Picture and Story



View from auditorium, with stage curtains parted, showing the four exponential horns on movable frame, together with organ console in orchestra pit. The four horns practically cover the entire area of the movie screen, thus distributing the voices evenly.

Below is shown close-up view of one of the large exponential horns, four of which are placed back of the movie screen.





The projector "voice reproducer" for "talkies," where the voice is recorded on the same film with the picture, appears above.

The microphone which picks up the voice of the actor is usually placed ten to twenty feet in front of him, as one of the photos herewith shows, the microphone being indicated at M, while the motion picture camera, C, is placed inside of a sound-proof cabinet. We understand that at least one manufacturer of motion picture cameras has now perfected his camera to the point where it is noiseless, and this will or should obviate the necessity of placing the camera and the operator inside of a stuffy sound-proof cabinet.

In the first class of talking motion pictures, the voice is recorded as previously described on a wax record in the laboratory, which may be located at any convenient or necessary distance from the point where the pictures are being photographed. In some instances the picture has been photographed several miles from the sound recording studio, the voice currents traveling over a telephone wire spanning the intervening distance to the recording studio. For that matter, a picture could be photographed in Hollywood, Calif., while the voice currents could be picked up by microphone and transmitted over a trans-continental telephone circuit or via radio to a sound recording studio located in New York City, if necessary.

In reproducing the voice or music from a disc record, an electric pick-up is used. The voice groove undulations are thus converted into electrical voice currents, which are passed through a suitable vacuum tube amplifier; after being amplified the voice currents are led over wires to the loud speakers back stage or at other locations.

Now we come to the second distinct class of talking movies, wherein the voice is recorded directly on the same film as that containing (*Continued on page* 1204)

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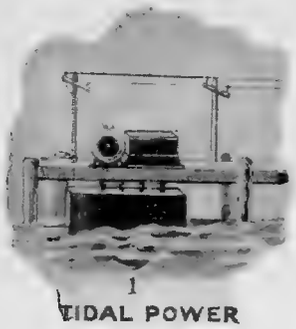

1
TIDAL POWER

2
STOVE-LESS HEAT

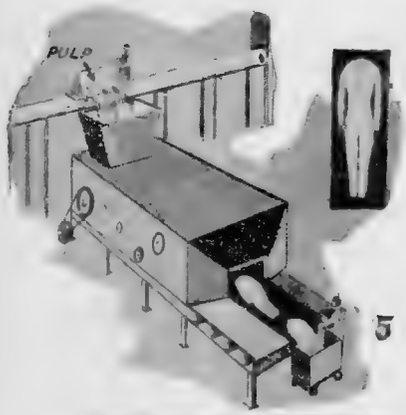
3
COOLED HOUSES

4
TOO MUCH HAND LABOR ON PRESENT SHOES

Trail Blazing To Millions

By ROGER W. BABSON

Famous Statistician



5
THREADLESS CLOTHES

OFTEN when a young man is talking with me, I detect a feeling of, "Well, it's too late. There isn't much chance now of adventure, of romance, of invention, of discovery, of development and of great deeds. I was born too late. Nearly everything has been done."

Many years ago, my statistical organization was engaged in a study of American industries for a large publishing company. The editor wanted us to find an industry in which no one was making any profit. His motive was a desire to help put that ailing industry on its feet.

We studied the situation for months. We studied the basic industries—food manufacture and preparation, furniture, clothing, shoes, matches, electric lighting, etc.

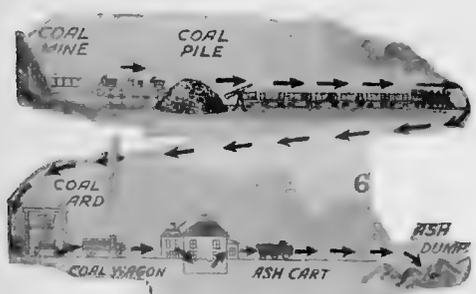
In each industry, in every branch of activity, somebody was making millions of dollars!

There was no industry in which some concerns were not earning handsome profits. Of course, there were many failures, too; but the trouble was not lack of opportunity in any industry—but a lack of mental ability and foresight.

For instance, all about us we have

(*Continued on page* 1189)

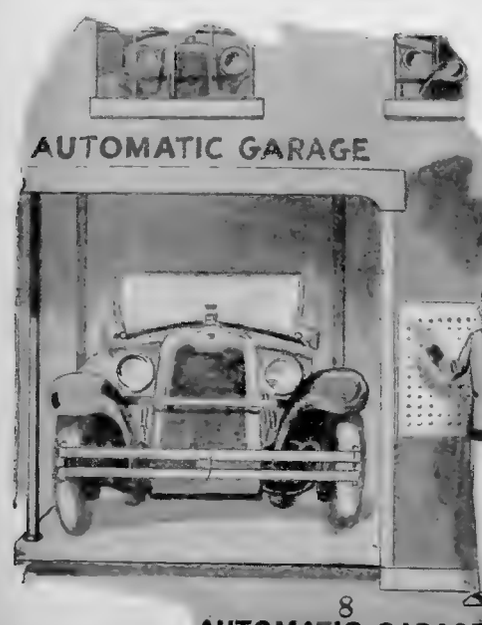
9



6
PRESENT WASTEFUL "COAL CYCLE"

7
FUTURE "COAL CYCLE"

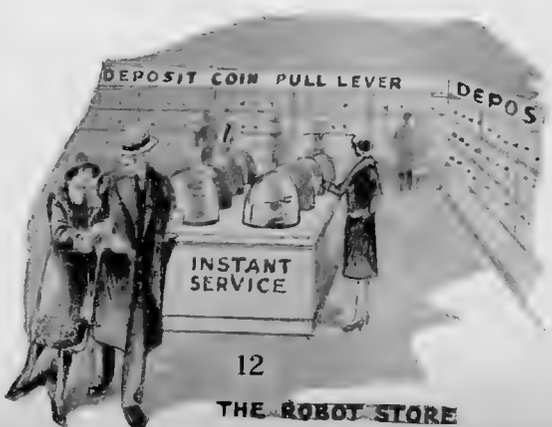
10
FUTURE AIR TRAFFIC



8
AUTOMATIC GARAGE

11
TRANSPARENT METAL TO-MORROW

The illustrations appearing here show but a few of the inventions and improvements which could be made to save both time and money, as well as make a fortune for the inventor. Numerous opportunities for improvement and development offer themselves in our present-day industries. Greater wealth is available today than ever before; much remains to be done and work along the suggested lines may prove to be a gold mine.



12
THE ROBOT STORE

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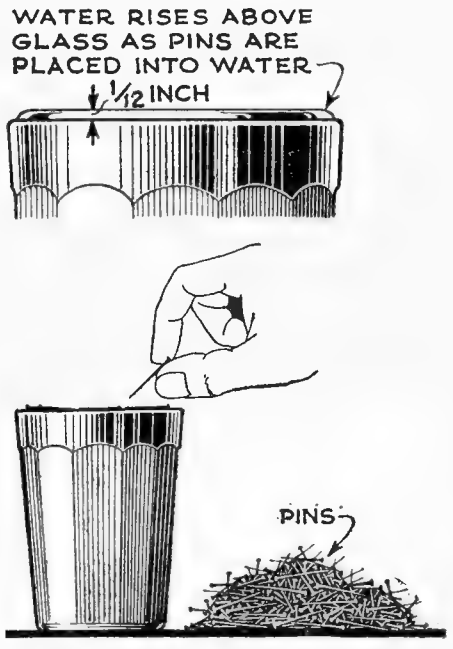
Oddities *of* Science

By B. P. ZIEGENER

THERE are many things in daily life of which we in our ignorance often form an entirely false idea. While we on the one side are inclined to give too low a value to objects entirely unknown to us, on the other hand, the number of those things is just as great whose mere description excites an over amount of valuation. This is especially the case when the dimensions or weight of various quite familiar objects are brought to our attention.

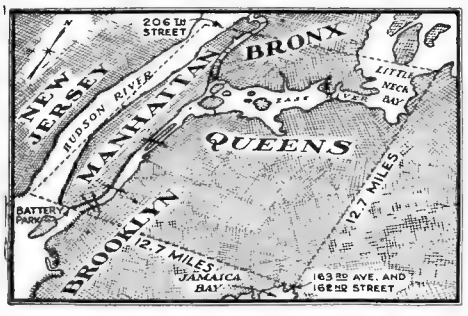
As an example, we justly look upon cork as a very light substance. We hardly notice its weight if we poise a bottle cork in our hand. Now if the question came up of how much a cork ball of one meter radius would weigh, our answer would probably give very limited statement of its weight. But all those who are clear in their minds about it and know that such a ball is rather higher than an ordinary full-grown man and, of course, equally thick and wide, would hardly give the right solution as over one ton. Such a weight one would never attribute to the light cork.

Now, while we undervalue a cork, we are on the other hand greatly inclined to overvalue a substance with which all are familiar, namely, metal. Suppose we take for instance, a common wine glass, and fill it to the brim with water. The question now comes up: How many pins can one put into the glass full of water without making it overflow? "Well, at the most, it is a dozen," is what the reader will say, but how astonished would he be if the experiment showed that well over a thousand pins can be put into the glass without one drop of water running over the brim. Yes, a little grating can be made over the surface of the water if so many pins cannot find place within the glass. Yet nothing overflows. The explanation of this apparent contradiction is easier to give than would ordinarily be believed. In the first place, we must consider that we have a little excess of room, because the water naturally doesn't overflow when it reaches the edge of the tumbler, but rises a little way above the edge of the glass in a convex shape, due to its surface tension. Then we have also greatly overestimated the volume of a pin. The following simple calculation will bring our estimate down to the actual dimension: For a pin we have a volume of about .00036 cubic inches. Now let us return to our wine glass. At the top it may have a diameter of a little over three inches, so that the surface of the water if the glass was filled exactly to the brim would have an area of 7.55 square inches. Now it is known that water can rise about one-twelfth of an inch about the rim of the glass containing it before it runs over, so if we fill the glass exactly to its brim we could, with a little care, add an additional .62967 cubic inches of water or the same volume of needles, without any danger of an overflow. But now as the volume of a pin calculated from the above figures has a value of about .00036 cubic inches, it follows that to take up the volume of 0.63 cubic inch would require about 1,750 pins. Now if anybody would take the trouble to count out 1,750 pins, and to put them at random in the glass they will find that in reality a little mountain of pins will be formed that will completely fill the glass and will rise above the level of the water, although the glass is filled to the brim and will not make it overflow. So here is a simple demonstration of the apparently impossible.

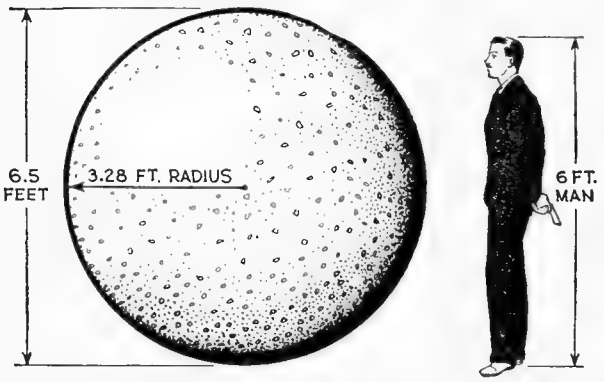


A surprising number of pins can be introduced into a full glass of water, the water rising above the edge of the tumbler as shown, oftimes to a height of one-twelfth of an inch.

But not only does metal go beyond the goal of our comprehension. Suppose now that all the men living in the world, about 1,500,000,000, were all put together standing close to each other on one place. How large would the area have to be that this mass of mankind would cover? Among the many answers which would be given to this question hardly one would come near the truth, even if a very quick calculator had figured it out, but yet had not hit upon it. Let us figure now that three men could stand close together on a square yard. Then five hundred million square yards would be required or equivalent of 161.4 sq. miles; size 12.7 by 12.7 miles, see illustration of New York City herewith for comparison. This number seems very large but if recorded as square miles then it seems something quite different although it is exactly the same thing. But the great astonishment is reached, when we bring this dimension into practical life and have to realize that the apparently enormous area is not as great as the area of Lake Constance! In fact, this would seem very wonderful to us at first sight, but it is true, for at the mean water level Lake Constance covers an area of a little more than five hundred million square yards, while all mankind needs a little less space. Now if we picture to ourselves that Lake Constance is frozen over, then all the living men on the earth could find room on this area, absolutely minute compared to the surface of the earth. And there is no need of their crowding either.



If all the men in the world, about 1,500,000,000 were placed standing close to one another, how large an area would they cover? The dotted lines in the illustration at the left shows the space which would be occupied, only about 161.4 sq. miles.



A cork ball about 6½ ft. in diameter has the surprising weight of over one ton. Such weight is rarely attributed to this light substance.

And now as we have got to Lake Constance, another question is to be asked and answered. If the sheet of ice under the great weight of the men should break, how much higher would the water level rise? Would a spring flood be the result of this sudden rise of water? Enlightened by the previous examples our cautious minds this time and hereafter would use small figures. Nevertheless, the fact is surprising; the water level would rise only about seven inches (*Continued on page* 1182)

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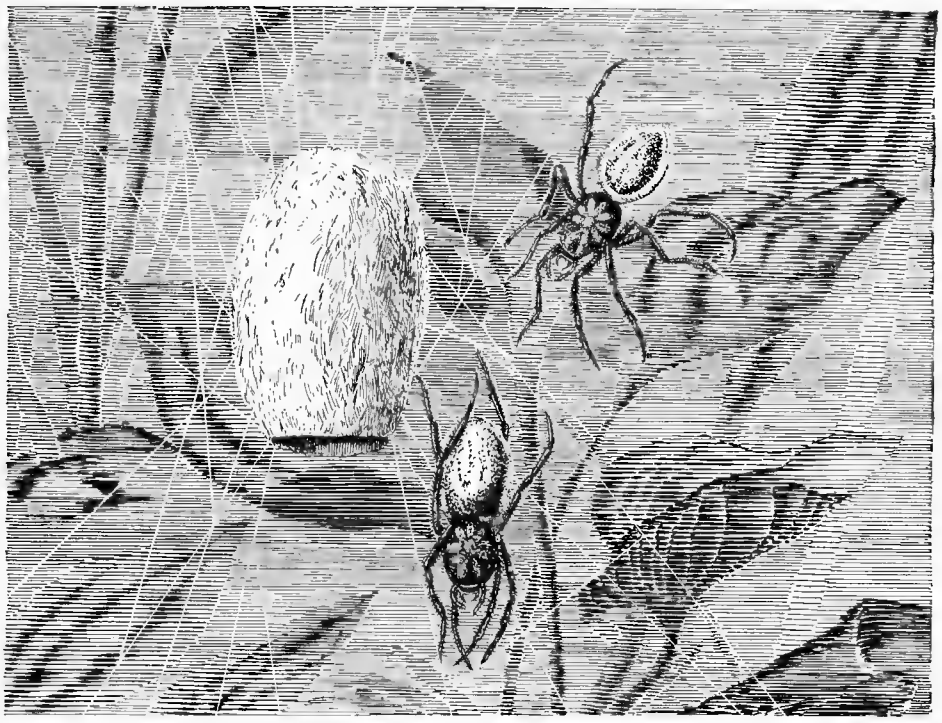

The above illustration shows Argyroneta Aquatica, the underwater spider. It is small and covered with a thick cluster of fine hairs. This spider is brown in color.

This Spider Lives Under Water

By DR. ERNEST BADE, Ph.D.

One of the Strangest of All the Arachnids Seeks the Water for Its Home. A Special Chamber or a Snail Shell Offers Protection During the Winter

ONE of the strangest of all spiders, and some of them are strange enough, is the diving spider that builds its home under the water. Why a land creature should seek the water for its home is a mystery that has not been solved. This spider differs in no respect from other arachnids. True, it is small and covered with a thick cluster of fine hairs and is brown in color, but it must breathe the air through tubes on its abdomen like others of its kind.

By an ingeniously built diving bell which it fills with air, it is enabled to remain under water for an indefinite time. It lives in this self-built chamber of air, and only leaves it long enough to catch its prey, which consists of any animal it can overpower. After returning to its home from its foray, it eats its meal within the security of its chamber. Food caught and not eaten at once is attached to its home with strands, where it remains until required.

The winter is passed by this spider either in specially closed chambers built under the water or they seek an empty submerged snail shell, fill it with air and, after entering, seal the opening. The shells may be found in the water or near the margin of swamps, lakes or ponds.

In the spring, when the waters are warmed by the sun, the spiders come forth from their retreat and begin the building of their new homes. Instead of building webs to catch their prey, they build diving bells. First the creature, while at the surface of the water, throws or spins a very delicate web about its abdomen with the aid of its hind legs. Then it dives down under the water, a large bubble of air surrounding the abdomen. This permits it to remain for quite a while below the surface.

That this is the case is proved by the fact that if the abdomen of the spider is treated with a drop of ether, the ether will dissolve the silky substance thrown out by the glands of the abdomen and worked about it with the legs as already described. This sticky substance may then be removed with a brush. If the spider is then released, it is unable to carry a bubble of air with it down under the surface of the water.

After the spider, with its silvery, glistening bubble of air has dived into the water, it begins to weave a thin but exceedingly strong homogeneous web which is then anchored with numerous lateral threads to any convenient object such as stones, submerged leaves, sticks, etc. There is no particular shape to this web at this time.

As soon as the structure is finished to the satisfaction of the spider, it swims to the surface of the water, lifts its abdomen into the air, dives down again under its structure and strips off the bubble from its body. The bubble rises under the web and lifts it slightly. Again the spider rises to the surface, obtains another bubble of air, returns below the nest, strips off this bubble, which then rises and joins the previous one. In this way the spider works continuously for about one hour until the diving bell is filled with air. As the air is added, the web assumes a more or less pear shape. It resembles a balloon straining at its anchoring cords.

When this diving bell is com- (*Continued on page* 1180)

The glands producing the spider silk on the abdomen are shown above enlarged.

A Mystery of Nature

WHY a land creature should seek the water for its home still remains a mystery to be solved. The underwater spider differs in no way from others, except for a covering of thickly clustered fine hairs.

The foot of the spider enlarged and clearly showing the comb appears here.

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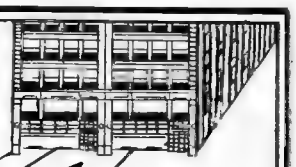

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Stage Mechanics

vided by a number of large cannon balls, which fall down through a specially constructed noise chute, as the large illustration portrays. Several other choice varieties of ear-splitting noises lend their part to the grand finale of Magiser's soul-destroying machine. Among these we find huge loud speaker horns placed about the stage, and which hurl forth terrifying sounds from a phonograph record highly amplified through a large vacuum tube amplifier. A series of base drums with automatic beaters also "let go," while stage attachés fire off pistols; another man operates the thunder sheet, 12, (a long strip of sheet iron suspended from one end); aided and abetted by a large whistle, blown by compressed air. All the while the orchestra plays away at full (*Continued on page* 1209)

Back-Stage View of "Mima" Shown Below — A Masterpiece of Stage Technique

1, loud speaker; 2, drums; 3, lids covered with gold paper; 4, flickering light fire effect; 5, switch-board for whistle and gauges; 6, cannon ball crash; 7, telescope; 8, orchestra; 9, spark blower; 10, reflectors; 11, cycloramia; 12, thunder sheet; 13, scene inside of cylinder; 14, television scene; 15, motor and drums for raising and lowering scenes, also for raising telescopic door; 16, amplifier; 17, colored lightning strikers; 18, man firing pistols; 19, gauges; 20, whistle; 21, air tanks; 22, switch-board for regulating drums and lightning; 23, drop showing steel plates; 24, colored paper as fire sparks.

Painted by George Wal., © E.P.Co.

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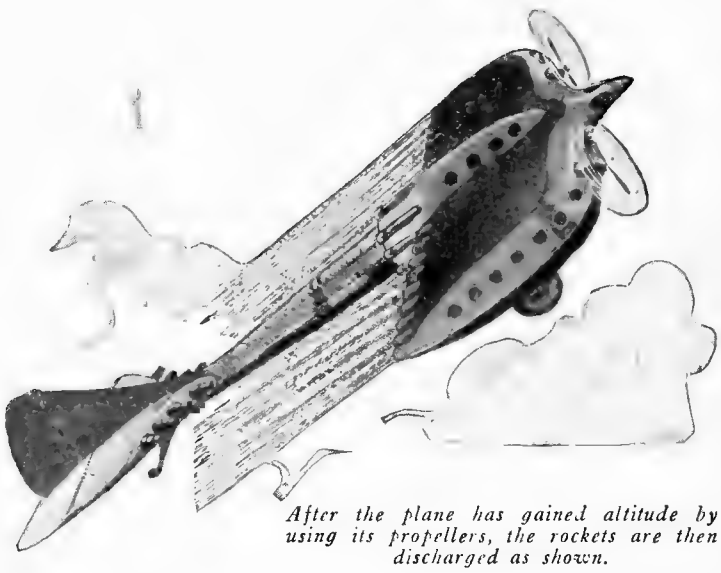
Berlin to New York in Twenty-Six Minutes

The above illustration shows a rocket plane in flight. The manner in which the retard rockets are used is also shown.

THE start of the stratosphere flight of the representative of the press was set for 13 o'clock today. On our arrival at the Tempelhofer Field, we were received by the superintendent of the Union for Aerial Travel, and the features of the rocket flight were described to us. The machine destined for the stratosphere flight seemed like ordinary commercial airplanes; it was different from these in size and the thickness of its air foils, in which the cabins for the passengers were placed. The body of the machine is proportionately small, and the same is to be said of its steering planes. In the body of the machine, between each two cabins, there is placed the rocket apparatus, with the nozzles of the rockets pointing backward. Very near the stern, there is another rocket system opening forwards which is designed to act as a brake on the velocity of flight, when a landing is to be made. The stratosphere plane has a pair of propellers, which at the start of the flight carry the plane up to a certain height before the alcohol-oxygen rockets can come into play.

According to the theoretical explanations, the most important parts of the machinery and arrangements were explained to us, as well as the arrangements for making and purification of artificial air and the heating apparatus. All these apparatus resemble the corresponding parts in a submarine. The entrance door to the body of the machine has leather gaskets. During the flight, it is tightly closed with bolts and wing nuts. The windows of the cabins are closed air-tight and the walls of the plane are made of lead glass of a dark gray color. The dark gray window panes only let a little daylight pass through them, so that the interior even in sunlight is lighted electrically. The walls of the cabins and the floors are upholstered with leather, and are covered with granulated cork composition. On the deck, on the walls and on the benches, there are numerous hand straps by which the passengers can pull themselves out when they have lost weight by diminishing gravitation. The special interest lies in the cabin benches placed at right angles to the line of flight. The benches are anatomically shaped, cushioned divans, over which a net can be stretched. In quick positive and negative acceleration on the plane, it is of importance that all ballast should be absolutely secured against motion, the luggage must therefore be contained in the cushioned and closed boxes bolted fast under the eyes of the flight captain. The entrance to the rocket chamber, on account of the danger involved, is naturally not permitted to anyone, but the captain's "bridge" can be inspected, in which, except for the crane for raising and lowering the rockets and the racks for holding them, there is nothing especially new to be seen. It must be noted, however, that in the pilot house there is a speedometer to be used for regulating the acceleration and the retardation of the flight. The latter corresponds to brake action. There is also an actinometer for measuring rays, and finally, on the outside wall of the plane, there are various thermometric instruments, which indicate the low temperatures of the stratosphere.



After the plane has gained altitude by using its propellers, the rockets are then discharged as shown.

The Tempelhof aviation field in Berlin could be used for landing and take-off of the planes.

It was 20 minutes to 13 o'clock before these explanations and the sight-seeing was over, and when we began to close our baggage, we found our "bath-tub" and drew the net like a mosquito screen over us and fastened it down with snap-hooks. It was 30 seconds before 13 o'clock, and the bell of the clock rang. After ten seconds, there was another ring, and then, my heart beating, I waited our start. 13 o'clock came, and the announcement "We're off" came through a loud speaker, and at once we heard the sound of a propeller driven by a compressed air turbine and felt that the machine was rising from the ground. We might have flown about three minutes, when the third clock bell rang; a tremendous noise began, and I was suddenly pressed backwards against my seat, with gigantic force. At first, the tremendous pressure affected me disagreeably, and I almost had to part with the "ponies" of cheering liquors which I had drunk before the start. The pulses of my blood beat in my ear, and I felt as if I were being overcome by a giant. The pressure, with which my body was pressed against the back, prevented my free breathing, sweat poured down my face, and the bunch of keys in my pocket pressed against me heavily. My clothes suddenly seemed too small, and my shirt seemed drawn tightly around my body. I tried to move my limbs; my arm, which I stretched out so as to get at my watch—for the few seconds which had passed seemed to me like hours—suddenly seemed to weigh 100 pounds. It was with the greatest effort that I managed to get at my time piece.

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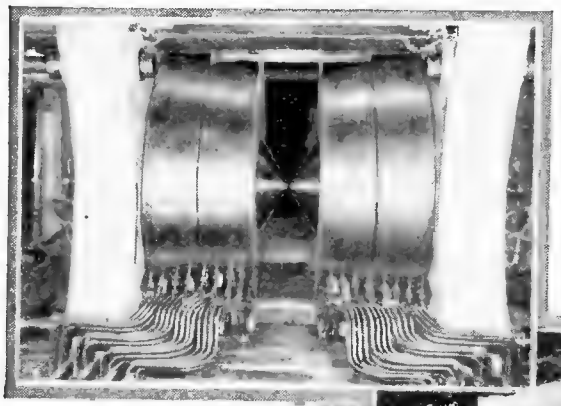
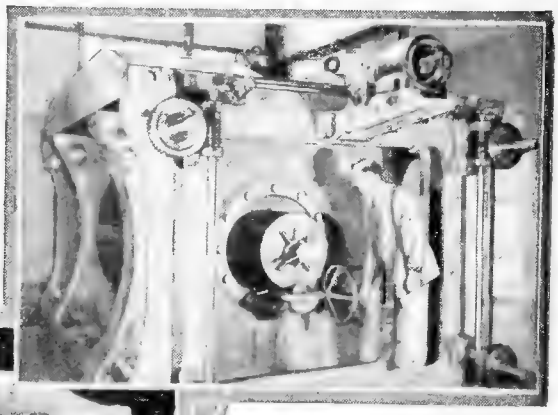
Researches on the structure of crystals and molecules will be undertaken with the huge magnet

French Academy Has New Monster Instrument Which Weighs 120 Tons and Is Made of 900 Pieces.



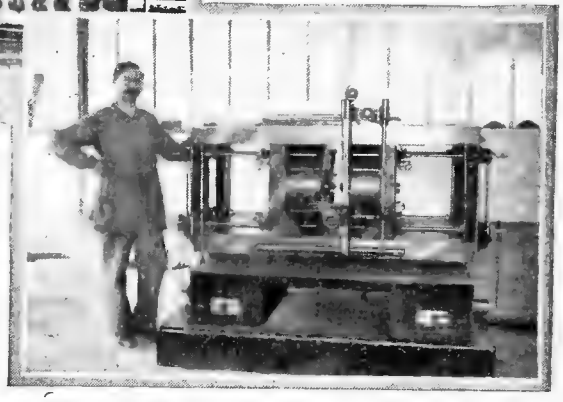
The photograph below shows the monster electro-magnet which has just recently been installed at the French Academy of Sciences. This gigantic construction weighs 120 tons and when in full operation will consume 2,500 kilowatts of electrical energy.



The view above illustrates a close-up of the gigantic electro-magnet, showing the wires which feed the coils. The coils themselves are made up of copper tubing, which is insulated, and through this copper tubing a supply of cold water is constantly circulated in order to decrease the heating effect. Suitable switches make the magnetic force variable.

By means of this and other controls the pole-pieces of the electromagnets can be moved through such slight distances that they will be accurate to the very fraction of one one-hundredth of a millimeter. Each electromagnet weighs 25 tons and it is moved by an electric motor, which in turn is manually controlled. This photo shows an end view.

The machine shown on either side is the developmental model from which the huge structure indicated above was designed. At one time this was considered a large electro-magnet and was extensively employed for experimental work.



By

COUNT A. N. MIRZAOFF

THANKS to the recent successful national subscription during the drive for the Pasteur Day, France has been able to donate to the French Academy of Science, the largest electro-magnet that was ever constructed.

Instruments of similar type which have been in use up to the present time in various laboratories, were capable of producing powerful magnetic fields, but their use was limited to only a few cubic millimeters.

However, the latest installation can produce the same magnetic fields, but covering spaces of several dozen cubic centimeters; or, figuratively speaking, one million times more. These magnetic fields can be kept up constantly for several hours. In this period of time, it is possible to install, for example, a small electric furnace or a liquid air chamber in which one can work under low or high temperature, which up to the present time it was impossible to attempt.

This remarkable instrument will function normally by consuming only 100 kilowatts of energy. This is relatively small, but it permits experimenting at a very low cost.

It will lend itself to higher power quickly and when necessary to obtain more powerful magnetic fields, it can be put to work at an expenditure of 2,500 kilowatts of energy. This is the maximum amount to be utilized at the National Bureau of Scientific, Industrial and Inventive Research at Bellevue, Paris.

The instruments of this type which are in actual use at present do not weigh more than one ton and a half. The new giant electro-magnet weighs 120 tons (some of the largest locomotives in existence weigh only 110 tons). One can thus easily imagine the size of this great electrical instrument. The frames at the base are 75 cm thick (29½ inches) while the main base on which it rests is 1m and 20 cm thick (47¼").

The whole instrument is made up of 900 pieces, this does not include the 1,400 various kinds of screws and 1,800 pieces of insulation.

The windings are made of copper tubes through which passes a current of water for cooling. It has required a tube of copper five and a half kilometers long (*Continued on page* 1182)

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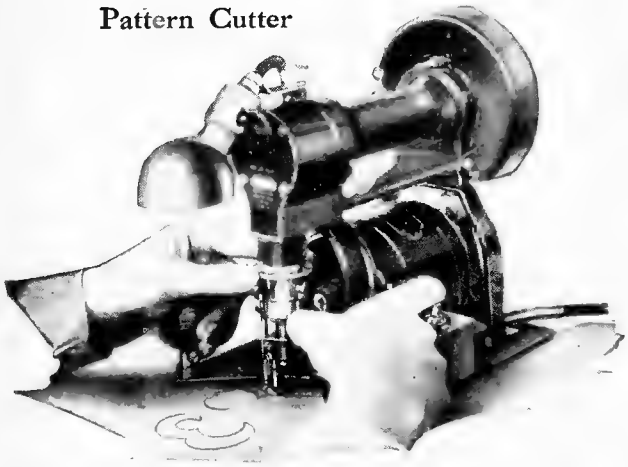
NEW DEVICES

FOR EVERYDAY USE

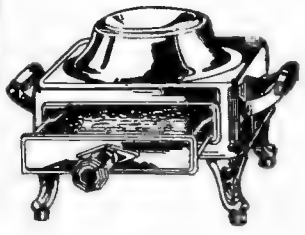
Pattern Cutter



The above photograph shows a useful instrument which can be used for cutting patterns from wood, rubber and the like.

Combination Percolator and Toaster

The photograph at the left shows a combination coffee percolator and toaster. The toaster uses a heating element located above and below the bread and, therefore, toasts it on both sides at once. The illustration below shows the toaster with flat wire rack for bread.

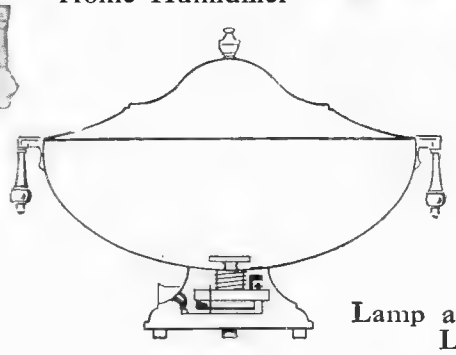


Electric Drink Mixer

An electric food and drink mixer is shown above. Motor in base starts automatically when container is placed on the stand for mixing.

Above: An electric humidifier which restores the necessary moisture to air in a heated room. Deodorants can be added to the water. Drawing at right shows automatic "no-water" circuit breaker.

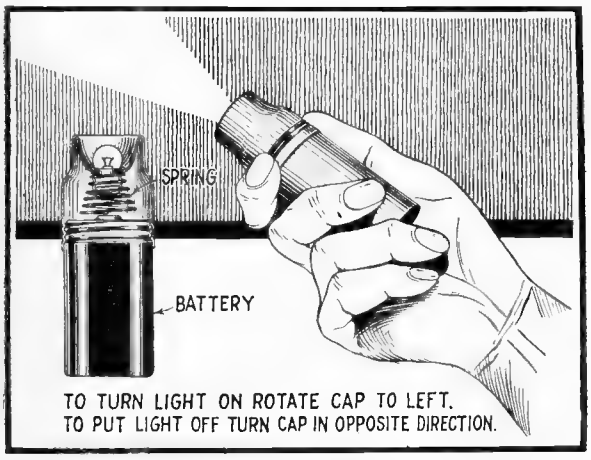
Home Humidifier



Lamp and Cigarette Lighter

Above is a combination lamp and cigarette lighter. Switches are provided at a convenient height for operating both.

Pocket Flashlight



The above illustration shows a small pocket flashlight which employs a clever mechanism for switching on and off. The cap is rotated to the left for turning the light on, and is turned in the opposite direction for putting it out. Details appear above.

Waffle Iron

An electric waffle iron with a heat indicating meter on top appears here. A piece of thermostatic metal moves a pointer over the scale, which has a red sector. When the needle lies within this section, the proper temperature for baking waffles has been reached.

Names of manufacturers furnished upon request.

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ARTICLE NUMBER 10 IN A SERIES

Details for Making an Artistic Spiral Turned Table Lamp Which is Easily Constructed by the Amateur Wood Worker

WOOD TURNING

By

H. L. WEATHERBY

Lamp

The finished lamp, together with the shade, is shown in the above photograph. This is made of black walnut with natural finish.

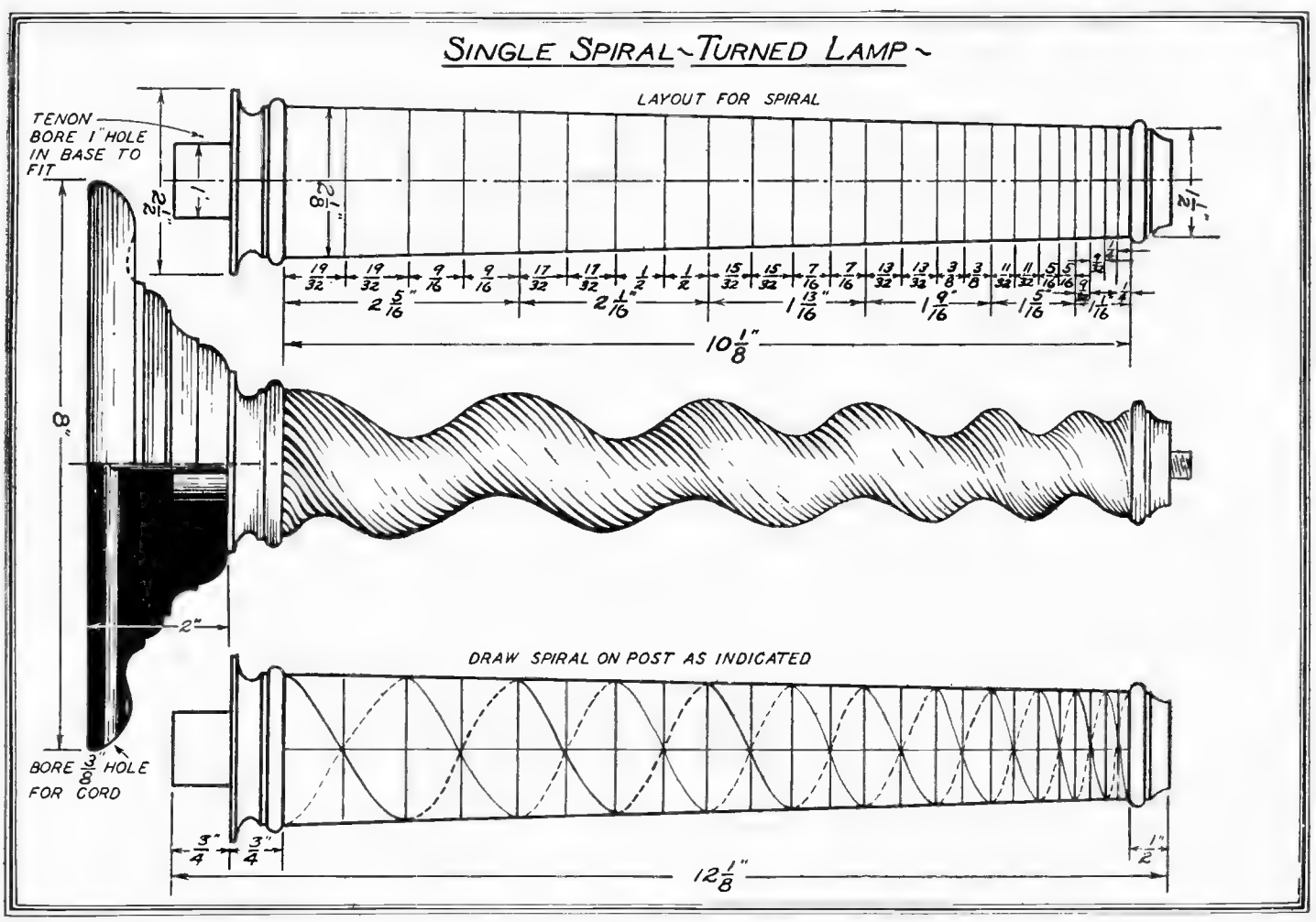
SPIRAL turning is not as difficult as it appears to be at first glance. Although truly a turning project, it involves considerable hand work, but anyone who can do ordinary turning will have little or no difficulty in turning the table lamp illustrated herewith. Spiral turning finds a considerable place in fine modern furniture and the amateur woodworker in his home workshop can turn out tables and chairs with twisted legs, pedestals with spiral posts, table and floor lamps in this style and many other beautiful and useful articles. The turning lathe in many ways opens up a wonderful new field to the amateur craftsman and spiral turning is just one example of this.

A slightly different type of lamp made by the author may be seen at the right. The shade used will, of course, depend upon the builder's own taste.

Preparation of Material for the Table Lamp

AS explained in the February number of SCIENCE AND INVENTION, describing the floor lamp, the post must be bored for the cord before it is turned. It is rather difficult to bore this hole with the ordinary bits to secure a perfectly straight hole, and it must be absolutely true or the bottom of the spiral cuts may break through into the hole and ruin the lamp. In order to obviate this, it is well to make the post from two pieces glued together, with a square groove down the center, made, of course, before gluing. This will usually be found to be the most satisfactory procedure to follow in

(*Continued on page* 1205)



Plans for making the single spiral turned lamp are shown in the above drawing. A good grade of hard close-grained wood, such as walnut or mahogany, is recommended for its construction.

A pattern is given above for the spiral post. The sections should be measured off as indicated and lines drawn around the post at each point while the lathe is in motion.

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READERS FORUM—

SCIENCE AND INVENTION desires to hear from its readers. It solicits comments of general scientific interest, and will appreciate opinions on science subjects. The arguments pro and con will be aired on this page. This magazine also relishes criticisms, and will present them, whether caustic or not. So if you have anything to say, this is the place to say it. Please limit your letters to 200 words or less, and address your letters to Editor—The Readers Forum, c/o Science and Invention Magazine, 230 Fifth Avenue, New York City.

The Houdini Message

Editor, SCIENCE AND INVENTION:

Recently in one of the newspapers published near my home I saw a picture of Mrs. Houdini and under it it told of her receiving a message from her husband, Harry Houdini, through the medium of a noted spiritualist.

Now, I never have believed in Spiritualism, and do not now, but would you kindly let me know as to the correctness of that article? I read in your magazine that Mrs. Houdini and her husband had agreed upon a message to be sent after his death and the newspaper article even went so far as to say she admitted it was the one agreed upon.

Of all magazines, yours is the one I look forward to with the most enjoyment as it fulfills the name within its covers, SCIENCE AND INVENTION. All others are merely filled with pictures and have no actual value whatever, while I find I can look over copies several years old and still find helpful articles that are never out of date in SCIENCE AND INVENTION.

THOMAS HARRISON, JR.
Spiceland, Indiana.

(It is perfectly true that the Houdini message has been delivered to Mrs. Houdini. According to the report which is substantially verified, Arthur Ford, a spiritualist, delivered the code agreed upon between Mr. and Mrs. Houdini. The words were "Rosabelle, believe" and the word "believe" was to be delivered in the code which was used by the Houdinis' and which can be found in the book called "Houdini—His Life Story" on page 105. The code message itself was, answer tell pray answer look tell answer answer tell. Previous to the delivery of this message Mrs. Houdini had withdrawn her award of $10,000 *but* SCIENCE AND INVENTION *had to this day not been notified of such withdrawal although according to reports, it was requested by the "spirits" and the press was accordingly notified.*

Subsequent to the delivery of the message, according to one newspaper which has several sworn oaths substantiating their findings, Ford actually admitted that he got this message directly from Mrs. Houdini and according to equally authenticated sources, unearthed by our Mr. Dunninger the message was obtained through a hoax from a person very much alive. At any rate, it is definitely proven that Ford was not in spirit communication with Harry Houdini. The SUN *stated that Ford was expelled from the Manhattan Group of the United Spiritualists League, for "conduct unbecoming a spiritualist minister."—EDITOR.)*

Radionic Machine

Editor, SCIENCE AND INVENTION:

As a reader of your magazine will you please give me your opinion and information, if possible, on the Radionic machine and its treatments; it is made by Calbro Magnowave, Inc., Omaha, Neb.

I am troubled with a Bronchitis and they claim they can do me good and cure it, but with so many fakes on the market, I am afraid to chance it unless I find out from good authority that it is O. K. They first find out your trouble and ailments with an electric sort of a radio and then treat you accordingly. Could any harm come from such treatments?

E. MEISTIRLING,
Albuquerque, N. Mexico.

(Up to the present time no machine has been designed which will diagnose illnesses nor has any mechanism been designed which will treat all illnesses electrically. It is true that the medical profession has its electrical appliances but they all have their definite and distinct purpose. The market today is still being flooded with mechanisms which claim to do what is well nigh impossible. These devices claim to diagnose illnesses from a drop of blood. Some supposedly operate directly from the patient.

You may rest assured that the individual who discovers such a system for disease diagnosis will become worldly famous in a short time and in as short a time become very wealthy. There is not a physician in the entire country who would not care to have a machine in his office that would instantly tell him from what diseases his patients suffer. You may rest assured that the mechanism about which you inquired will not relieve you of your condition any quicker than nature itself. We could do no better than to suggest that you go to your local hospital or your family physician. You will save both time and money. — EDITOR.)

IN THE APRIL "AMAZING STORIES"

THE REVOLT OF THE ATOMS, by V. Orlovsky. Like every other new idea, the theory that the energy contained in the atom, if released, would be sufficient to blow the world up, is denied by other scientists. They maintain there is no danger. We cannot tell now, which school of scientists is right, but this tale, which comes to us from Russia, is an excellent story of absorbing interest, not only as a piece of fiction, but for the science contained in it also.

INTO THE GREEN PRISM, by A. Hyatt Verrill. (A Serial in 2 parts) Part II. There can be very little doubt in the minds of those who have read any of Mr. Verrill's stories, but that he always has something unusually interesting to tell and that he knows how to tell it. Absorbing as the first instalment was, the concluding paragraphs exceed it by far with the astounding findings which the Indian scientist makes, looking through the green prism. Along with its surprise episodes, there is plenty of science in the story.

BURIED TREASURE, by Miles J. Breuer, M.D. We all know, that that which is extremely rare constitutes the greatest treasure. It is interesting to conjecture what might be a rarity a thousand years or more from now. Dr. Breuer has given us a brilliant scientifiction story in which is included a novelty feature, which we have gone to some trouble to reproduce for our readers in its original interesting form.

THE TERROR OF THE STREETS, by George McLociard. With the continually increased production of automobiles and the ease with which almost anybody can obtain a car, the streets have become a dangerous place not only for the pedestrian but for the motorist as well. If all those who drove cars were expert chauffeurs, the danger would be lessened considerably, of course. Under the present circumstances, however, some really drastic measures will have to be taken. Fines and imprisonments, apparently, are not enough. The author of this story, however, conceives an absolutely original idea and method for effectively combatting the evil—the careless driver—and weaves as clever a story around his invention as his invention is ingenious.

Exception Proves the Rule

Editor, SCIENCE AND INVENTION:

On page 882 of the January issue, there is a section entitled "The Exceptions That Prove the Rule."

In the name of common sense, how can an exception prove a rule? By definition, an exception violates a rule. If an exception could prove a rule, then the more exceptions, the stronger the proof. You would then have a complete ideal demonstration when every instance cited under a rule was an exception to it!

The popular overworked bromide about an exception proving a rule, taken as it reads or on its face, thus leads straight to absurdity.

Would Newton or any other mathematician consider the binomial theorem better established if the positive fractional exponent case, instead of falling under the theorem, had been an exception to it? Our daddies used to talk about the rule of three. If there were exceptions to it, do you think they would prove it better? Was Bode's law strengthened or weakened when the distance of Neptune was found to conflict with it? Would you consider the rule of chemical combinations better established, if occasional samples of H_2SO_4 did not exhibit the properties of sulphuric acid?

If "the exception proves the rule" is valid, the crank would have an immense advantage. Imagine one saying, "Heat generally causes bodies to contract." You reply by citing exception after exception. Mr. Crank immediately cries in triumph, "These exceptions prove the rule that heat causes bodies to contract."

Evidently, then, an exception does not, cannot prove a rule. On the contrary, it is a rule, preexistent or presupposed, that makes an exception possible. And an exception, far from proving or tending to prove a rule, has exactly the opposite effect of weakening or destroying it.

How did such an absurdity as "the exception proves the rule" gain such currency as it has? There is a plausible, perhaps valid, explanation. The old maxim of logic, in Latin, "Exceptio probat regulam" was mistranslated and the deadly deed was done. Instead of meaning "prove," the verb "probat" means "probes, tests, tries out." Mr. Exception does probe, test and try out a rule. If, then, he becomes

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THE EDITOR'S MAILBAG

too numerous, he does not *prove* but *smashes* the rule. That is not only good logic, but common sense as well.

RICHARD P. LOCHNER,
Philadelphia, Pa.

(You are right. Real exceptions do not prove a rule. In the case to which you are referring the "exceptions," when understood, do not violate the rule. They must first be understood, then they do not become exceptions, although at first glance this might so appear. We are pleased to use your communication here in argument against this still ever-popular but incorrect statement.—EDITOR.)

The Houdini Message

Editor, SCIENCE AND INVENTION:

As a reader of your magazine SCIENCE AND INVENTION I am aware of your fight against fraudulent mediums and your money awards for genuine phenomena.

The article enclosed appeared in the Jan. 12 issue of "The Buffalo Evening News." Knowing that there is a $10,000 award for the Houdini message and as your magazine said nothing of it being claimed or given, I want to ask "How Come?"

I suppose it is a mere stunt to draw in the lucre, but couldn't you give Mr. Russell a ride?

J. C. CUNNINGHAM, Jr.
Johnsonburg, Pa.

(We refer you to the first communication answered this month. Further information on this Houdini message appears elsewhere in this issue.

SCIENCE AND INVENTION *has an offer of* $10,000 *which is open to Mr. Russell if he will read a message sealed in an envelope by the editors and that envelope will be tacked to the table in front of him. Of course, it is understood that this message will be read by Spiritualistic means not by tearing the envelope open and noting its contents.*—EDITOR.)

Church of
Spirit Communion
Terrace Room, Hotel Statler
Theo. C. Russell, Pastor
6 P. M., Free Message Circles
8 P. M.—Trance Lecture by the Pastor—subject
"Mediumship Our Heritage"
Message service by leading mediums, followed by a demonstration of ballot reading by
THEO. RUSSELL
Famous Medium
BRING SEALED QUESTIONS
EXTRA! Announcing the early appearance at this church of ARTHUR FORD, noted medium of New York City, through whose mediumship the Houdini test message was received.
Every Thursday Evening
Iroquois Room
THEODORE RUSSELL and other mediums. Sealed questions.

Read this clipping and then refer to the article elsewhere in this issue. It is plain to see that spiritualists do not want the truth advertised.

Seeing the Past

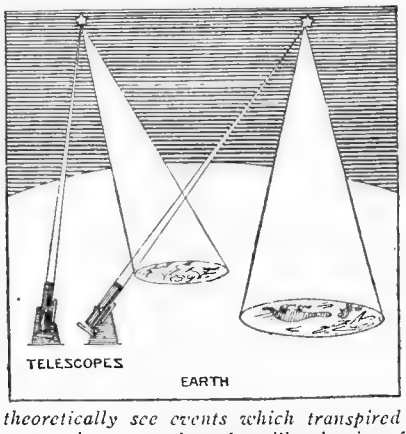
Editor, SCIENCE AND INVENTION:

I am a reader of SCIENCE AND INVENTION, and take a great interest in various scientific subjects discussed in this most interesting magazine. Being an amateur scientist myself, many ideas present themselves to me, one of which I will discuss here.

Records of the events of history date back many decades, and the geological records give us an idea of the happenings ages ago. And that is all! None of us have ever seen the many curious creatures of yesterday, nor pictures of many great events that took place long ago. We imagine how great tremors and glaciers changed the earth's crust, and how the prehistoric dinosaurs roamed the earth. But some day science may be able to change our visions into real scenes.

This advance will be based upon the velocity of light. The speed of light is 186,000 miles per second. With such a surprising velocity it takes fully 8 minutes to come from the sun to the earth. Therefore, we see events on the sun 8 minutes after they have actually occurred. In the case of many remote stars, their light travels for years before reaching us. These enormous distances are measured in light years.

Now we need a new telescope based on electrical magnification as the method of almost infinite magnifying possibilities. If we could spot a plane surface or mirror on some distant celestial body, we would be able to see the reflected images of past events of our earth. As the light of these is still travelling infinitely, some of it would be reflected from mirrors of varying distances and positions, and would ultimately reach our new telescope. Supposing a mirror to be one thousand light years distant, then we could see the images on the earth of two thousand years ago. As progress is made, we would be able to see events of the prehistoric ages in this machine or as motion pictures on a screen.



Such an idea is not impractical, and is a fair treat for the hungry scientist. Indeed, we ourselves may witness such scenes which would certainly outstrip our wildest imaginations. Similar scenes could also be seen on other planets. At any rate, it would open the secrets of the past, fill out the blanks of history, and be of great scientific benefit in every respect.

CLINTON CONSTANTINESCU
Lethbridge, Alta., Canada.

(While it is perfectly true that if we mounted a mirror on a distant planet we could theoretically see events which transpired on this earth years ago, you must also remember that illumination falls off as the square of the distance. For that reason any event, reflected from this earth, becomes fainter and fainter, until the amount of light which is sent off from that point is so infinitesimally small that it would have to be superamplified before it could be seen. Today we know of no means of light amplification.

While the microscope renders minute obstacles visible and the telescope brings distance closer, we still could not see any events which transpired on a planet as large and as close as the moon. It would be impossible for us to definitely locate buildings fully as large as the Woolworth on this body with even our most powerful telescope. Naturally we could not see people nor would we be able to see any animals. Yet, the plan which you have suggested might give some scientifiction story writer food for thought.—EDITOR.)

Deaf-Phones

Editor, SCIENCE AND INVENTION:

I wish to ask your advice about the newly so-called Vibraphones for hard-hearing people. I would like to know whether or not it is all fake. They sell for fifteen ($15.00) dollars. I don't care to take another chance, as I have paid out hundreds of dollars for medical advice and appliances in the last eight years. I am hard of hearing because of Catarrh. I have ear buzzes at times, and hear better in one ear than the other. Either ear may be the one which gives the loudest response, the order changing from day to day. I can hear loud talking or loud street noises.

Please give me your advice about Vibraphones and what will help my ears.

W. BASS,
Los Angeles, California.

(There is no known device today that will enable any deaf person to hear. There are many devices made to assist a partially deaf individual, if one would believe the testimonials, every one of the various fake contraptions and systems found on the market and everyone of the legitimate devices which are also found have at some time or other helped either mentally or physically. But testimonials are very easy things to get.

Our advice to everyone suffering from a condition making it difficult for him to hear well, would be to either write the company or to visit them or their demonstration centers and actually ask to try out the device, not for five or ten minutes but for an hour or hours. If it works you of course lose nothing by your purchase, if it does not work you go away a wiser man.

One of the best aids to hearing, if the person is at all able to hear, is a loud speaking radio set or if he is able to hear over the telephone, a microphone connected in series with an amplifier and this connected to the telephone receiver fitted on or in the ear. Vibrations may help some cases of deafness. They certainly will not help all cases. Your own might be one where they can be of no value.—EDITOR.)

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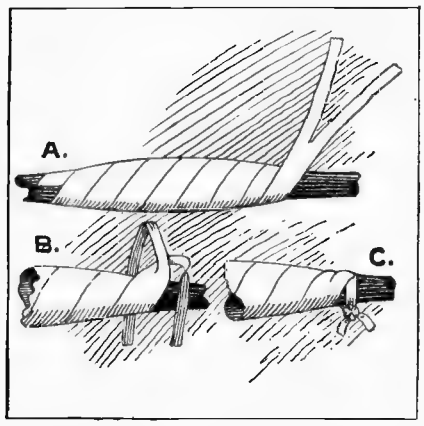
WRINKLES, RECIPES *and* FORMULAS

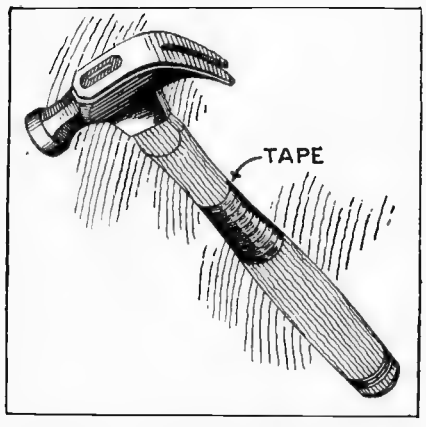
Edited by S. GERNSBACK

Taping Connections



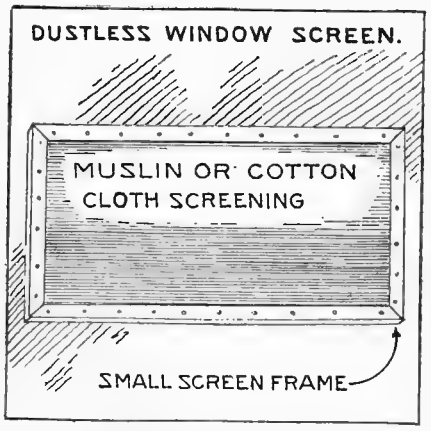
The above illustration shows a good method of taping electrical connections. After the wire has been wound with tape, the tape can be kept from becoming loose by splitting the free end, wrapping the two pieces in opposite directions and knotting securely.—C. F. Felstead.

Hammer Kink



Tape placed on the hammer handle as shown will prevent the hammer from slipping out of the hand and will also lessen the strain of gripping the handle.—Ivy M. Howard.

Window Screen



A dustless window screen is shown above. An old window screen frame is obtained and the metal screening removed. A sheet of white muslin or cotton cloth is tacked on the frame in place of the metal screening. This allows the air to enter the room but will filter out dust and dirt, as well as snow.—H. R. Wallin.

Cleaning Paint Brushes from Lacquer

I am sending you the following wrinkle on how to clean small paint brushes that have been used in lacquer. I discovered this method myself and have found that it works excellently.

Brush every bit of lacquer out of the brush upon an old piece of wood. This must be done quickly and completely to insure success. Take care to remove all lacquer in the bristles where they are fastened to the wood. Then dip the brush in water and brush the water out on a board. Repeat this several times. Then lay the brush away to dry until it is to be used again. If every bit of lacquer has not been removed, the brush may be found to be a little stiff. Bend the bristles with your fingers a few times and the brush will be found to be just as good as new!—*Contributed by Allen W. Baldwin.*

Caring for the Electric Starter

While the electric starters on motor cars are not subject to what may be called constant use they have an important duty to perform, and it is likewise a heavy duty, and for that reason the starter should be occasionally inspected, and adjusted where needed.

If the screws that hold the starting motor to the engine crank case work loose trouble will soon develop in the cranking attachment called the Bendix drive. It is therefore important that these screws be kept tight at all times.

When the starter makes an unusual grinding noise, that is indication that it is loose, or that the Bendix drive is at fault.

If the starter seems tight, remove the Bendix drive cover, or cap, and tighten the two visible cap screws, or have them tightened at the nearest garage.

Keep the storage battery fully charged, and if the starter will not crank the motor, do not continually depress the button until you have located the trouble because this may cause arcing at the brushes which will burn the commutator.

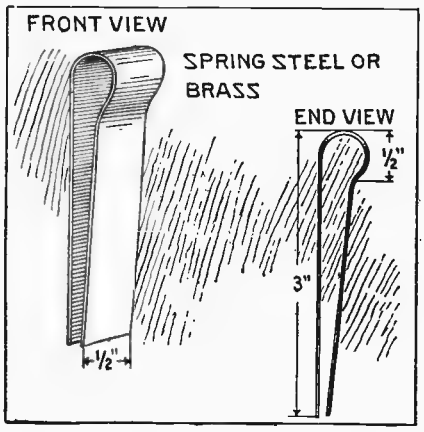
Starter trouble is most frequently due to a discharged battery or a loose connection in the system, providing, of course, the engine turns freely when cranked by hand.

If the engine can be cranked by hand, easily, and the starting motor works sluggishly, that is an indication of a discharged battery, worn brushes, or burnt commutator.—*Contributed by Glen F. Stillwell.*

Cleaning Spots on Clothes

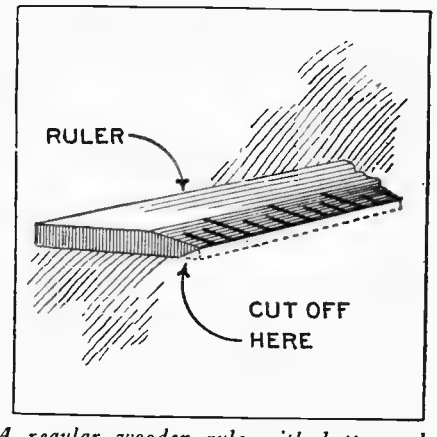
A practical cleaning device for removing spots may be made at home or by your tailor by rolling together pieces of horse-hair cloth and tweed into a "stick" and stitching. This makes a stiff cleaning device which, when soap is put on one end to loosen the dirt or grease, provides a utensil for brushing away spots without leaving rings.—*Contributed by E. L. Dunbar, Reporter 28789.*

Anti-Window Rattling Device



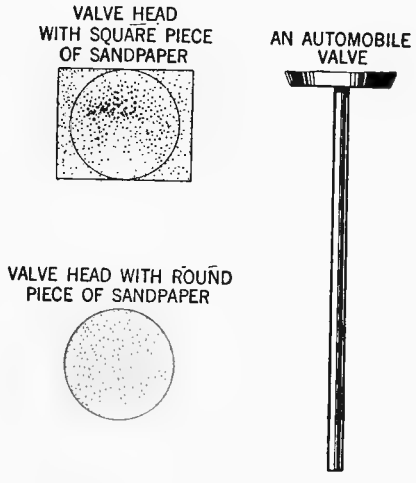
To prevent windows from rattling, the little device shown above will prove useful. A piece of spring brass or steel is bent in the shape indicated. This strip should be about ½ in. wide and 3 in. long. It is inserted between window frame and casing.—H. R. Wallin.

Non-Blotting Ruler



A regular wooden rule with bottom edge cut off with a knife and sand papered carefully can be used for making drawings in ink without fear of blotting.—Lawrence K. Loomis.

Finishing Tool



Secure an old valve stem and place a piece of sandpaper or emery cloth and fasten it on the head with cement. The stem of the piston will fit into a standard size hand drill which can be turned and run over the face of the panel for a dull finish.—W. B. Walker, Jr.

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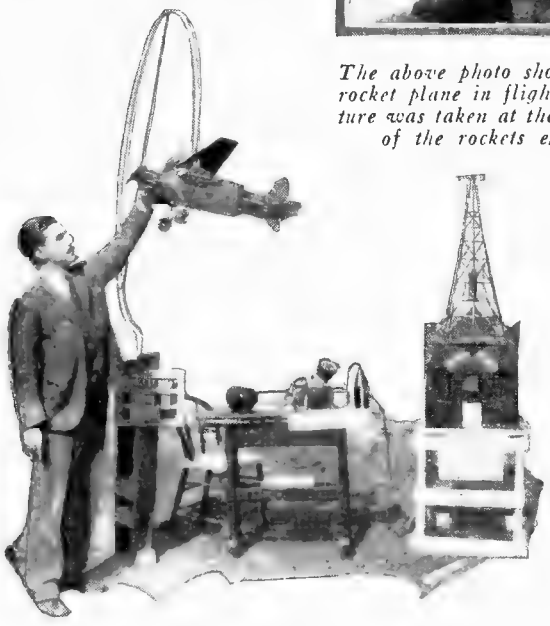
Model Rocket Planes

ROCKETS have been used as the impelling force for land vehicles, and now German aeronautical engineers are experimenting with model airplanes propelled by rockets. The model employed was similar to a toy plane and soared through the air for several hundred yards, under the impulse delivered by three rockets exploding at intervals. Although the flight was of short duration and the speed could not be computed accurately, it was estimated that the tiny plane flew on its circular course at about 100 miles an hour. The arrangement of three rockets on the tail of the model may be seen in the photo. A model rocket plane actually in flight is also shown here. The German engineers are confident that the rocket plane will be used eventually for overseas flight. Maurice Poirier, of Burbank, California, has invented a plane carrying 86 rockets. He is shown here demonstrating the miniature plane which he has successfully controlled by radio. The model is a tri-motor airplane of the Fokker type.

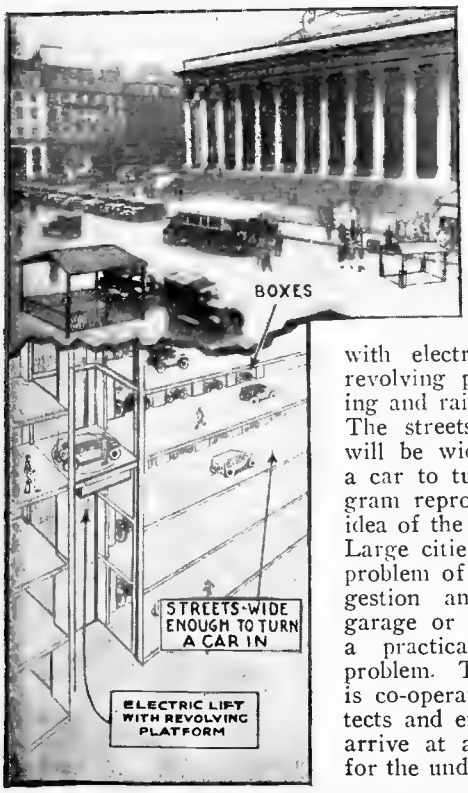
The above photo shows a model rocket plane in flight. The picture was taken at the instant one of the rockets exploded.



The photograph above shows a model rocket plane being prepared for its test flight. At the left is Maurice Poirier directing the flight of his plane by radio.

Garage Under Street

Underground Garage Will Provide Storage Space for Thousands of Cars Beneath the City



PARIS has solved the problem of motor parking with the design of an underground garage which will be constructed beneath the Place de la Bourse. The parking space will run to a depth of some 900 feet below the surface and is equipped with electric elevators having revolving platforms for lowering and raising the automobiles. The streets below the surface will be wide enough to enable a car to turn about. The diagram reproduced here gives an idea of the underground garage. Large cities are faced with the problem of growing traffic congestion and the underground garage or parking space offers a practical solution of this problem. The Prefect of Police is co-operating with city architects and engineers, in order to arrive at a satisfactory design for the underground garage.

"Down and Out" Fire Escape

A NEW type of fire escape is shown at the right. This is constructed entirely of steel and uses a sliding spiral type of escape which is of great value, especially for use with buildings such as schools and asylums. Entrances to the tube escape are arranged at each floor. A high safety factor is also obtained with this tubular escape, as it enables one to reach the ground more quickly than with the stair type. There is also security from a misstep or stumble. Time tests show the superiority of the steel tube fire escape over the older type. More than fifty children were emptied from a building in about 40 seconds.

The dangers of panic which often result in grave disaster and loss of human life are now entirely eliminated by the steel tube fire escape.—*Courtesy Making Markets.*

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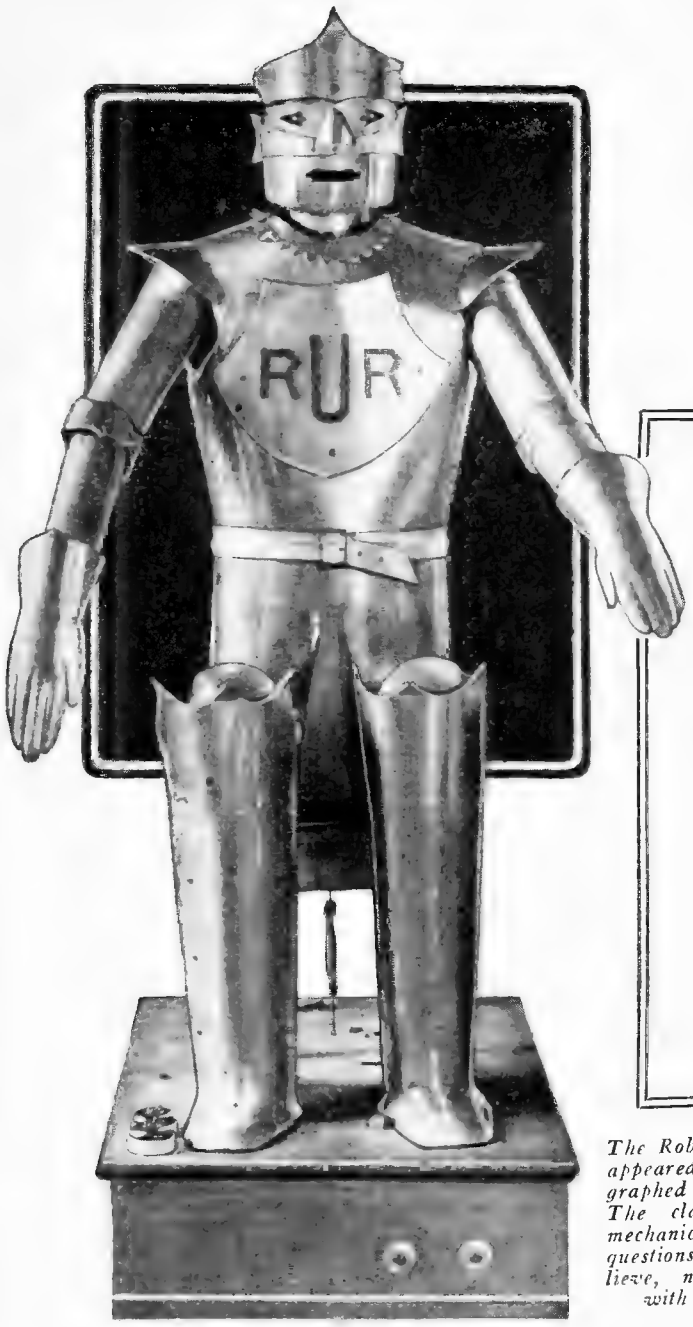
Science and Invention Offers a $300.00 Award

Is Robot Genuine?

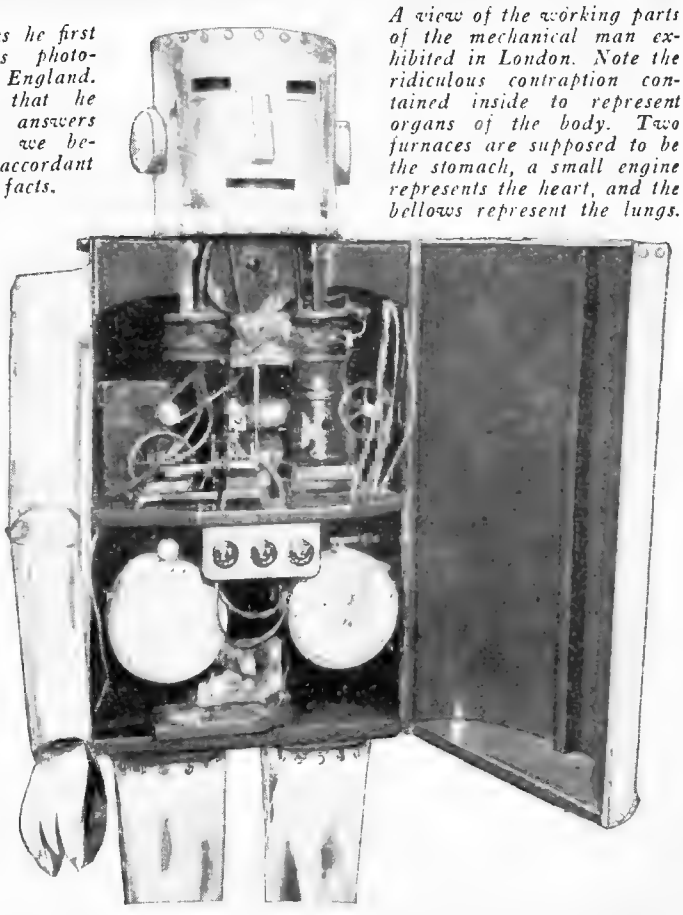


The Robot as he first appeared as photographed in England. The claim that he mechanically answers questions is, we believe, not accordant with the facts.

$300.00 AWARD

THIS magazine will pay $300.00 to any charitable organization mentioned by Captain William H. Richards, of London, the inventor of "Eric Robot," a six foot 140 pound metal-mechanical man, if the Robot will mechanically or electrically, correctly answer ten questions, even if he knows the answers thereof, and if the questions can be put to him by us in any order; on condition that no human agency is involved during the answering of these questions.

Captain Richards has claimed that Robot can answer hundreds of questions. It is the contention of this publication that Robot is operated by a human being concealed in or about the mechanical figure, and it is this human agency that answers the questions put to it, not any form of mechanical selecting mechanism.



A view of the working parts of the mechanical man exhibited in London. Note the ridiculous contraption contained inside to represent organs of the body. Two furnaces are supposed to be the stomach, a small engine represents the heart, and the bellows represent the lungs.

ON January 19th, the *New York Times* published an article on "Eric Robot," a mechanical man invented by Captain William H. Richards, of London. Quoting the *Times*—"Captain Richards explained that Eric was made of aluminum, copper, steel, wires, and dynamos, and moved by electricity. He said, while Eric required only 12 volts to move, he needed 35,000 volts to speak. . . . He denied that Eric is manipulated by anything outside his interior. . . ." Captain Richards said that, "he can answer hundreds of questions." In answer to questions from the audience, the Robot again and again told his age, counted to ten, and told the time.

Aside from the ridiculousness of the operating voltages necessary to make him speak, SCIENCE AND INVENTION distinctly questions the ability of the Robot to answer ten of the stipulated "hundreds of questions" in any order put to him, and to do so in a distinctly mechanical or electrical way. Repeated attempts to reach Captain Richards have been of no avail, but Mr. Lee Keedick, his press representative, has promised to invite us to the next demonstration of Robot's ability, which has not yet taken place.

This magazine contends that human intelligence is responsible for giving the answers to the questions, perhaps through amplifiers, but human nevertheless. We therefore and herewith post $300.00 to back up our contention.

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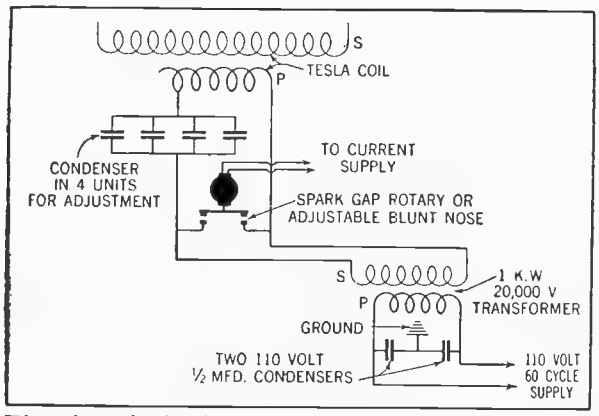


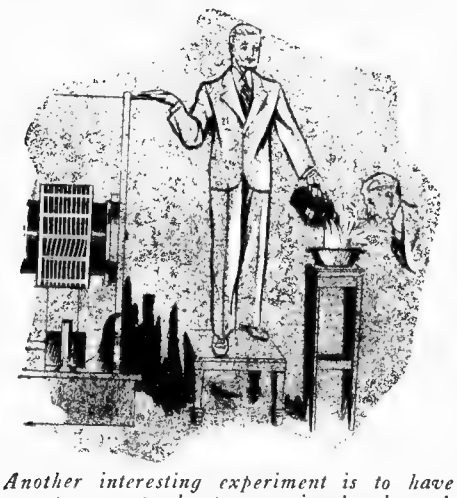
The schematic circuit diagram of the Tesla coil and associated apparatus is shown in the above drawing.

tape, well built up in the corners next to the end collars. The end collars are also made of ¼-inch fibre or bakelite, to hold up ends of secondary coil and prevent flash overs to core.

The secondary consists of approximately 36,000 turns of No. 34 enameled wire. The secondary must be very carefully wound and well insulated between layers. The layers do not need to be wound with machine accuracy, but can be wound 2 or 3 turns deep, if the winding steadily progresses across until a layer is completed. But never allow even one turn to throw back an inch or so over what has been wound, or a puncture between turns of several hundred volts difference in potential will result later.

Insulate each layer with a good sheet of .007-inch thick varnished cambric, and a layer of friction tape which is convenient to hold all the winding tight and compact. Do not wind the layers within ½-inch of end of insulation, or of end collar, so there will be no chance of any turns slipping down in the crack to other layer ends. Fill in that space on each layer with tape.

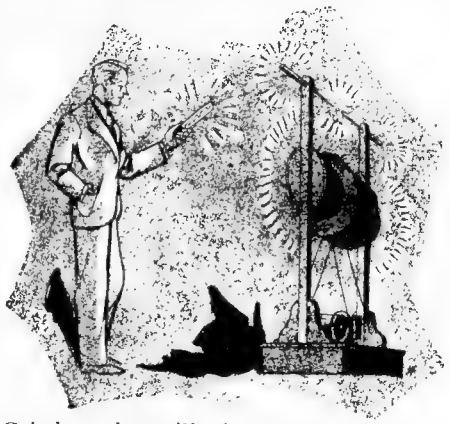
Connecting leads of heavier, flexible wire should be attached to the ends of the fine wire, and wrapped several times around the coil, to remove all strain from the fine wire. The inner lead must, of course, be attached at the start of the first layer, and should be brought out through small hole in the end collar, very well insulated from all layers. Do not try to bring this lead out inside the collar, next to the ends of all the layers of winding, or a puncture and short circuit will usually result. The secondary leads should also be attached to a fixed terminal strip. About 12 pounds of No. 34 wire, and 45 pounds of iron are required for this part.



Another interesting experiment is to have one person stand upon an insulated stool, make contact to a coil electrode and pour a stream of water from an aluminum pitcher with the other hand into a pan on a second stool. It is then possible to light a cigarette from the stream of water.

The High-Voltage Condenser

THE condensers can be built in three or four rubber or glass jars, to obtain flexibility or adjustment by connecting part or all of them in parallel. The totals should consist of 48 plates of thin sheet brass (.003-inch or .005-inch) thick and each 6 inches by 8 inches, or, if desired, a greater number of plates of smaller size, just so the total area is the same. Sheet brass was used in this condenser to eliminate part of the losses and heat obtained with tinfoil, and to make a more rugged condenser. The insulation consists of uniform double-strength glass plates at least ½-inch larger all around than the brass sheets, to prevent flash overs at the edges. Each group is tied and immersed in a jar of transformer oil. The finished condenser should be protected by a safety gap, of heavy wire pieces, set about 5/8-inch to



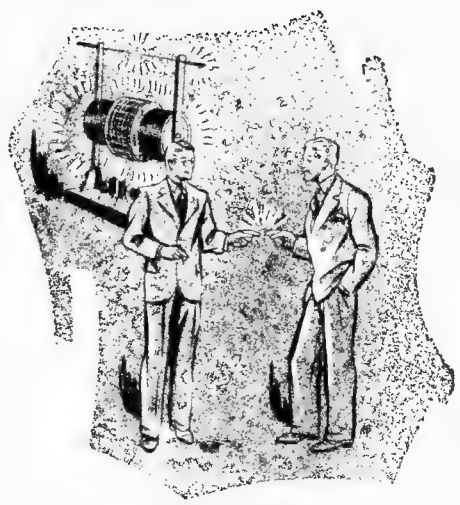
Geissler tubes will glow several feet from the coil when one end of the tube is held in the hand. Beautiful violet discharges can be formed in a large lamp bulb in the same manner.

¾-inch apart, at all times, to prevent breakdown of glass plates. Mica plates can be used in place of glass, if desired, and are a little thinner, but usually cost more.

How to "Tune" Circuits

THE spark gap can best be a good rotary type, but very good results can also be obtained with a plain adjustable blunt-nosed gap, with careful adjustment. These adjustments are all very important to get best results, and should be tried experimentally until best values are found for any given coil.

It is also quite important in the operating of such equipment to have all the wires connecting the various parts as short as possible and quite large, No. 12 wire or over preferred. This is because the "skin effect" of high-frequency volt-



Often two persons standing several feet from the operating coil and in no way connected to it, can draw sparks by touching their fingers together.

ages is very pronounced, and causes considerable loss in even a few inches or feet of extra wire.

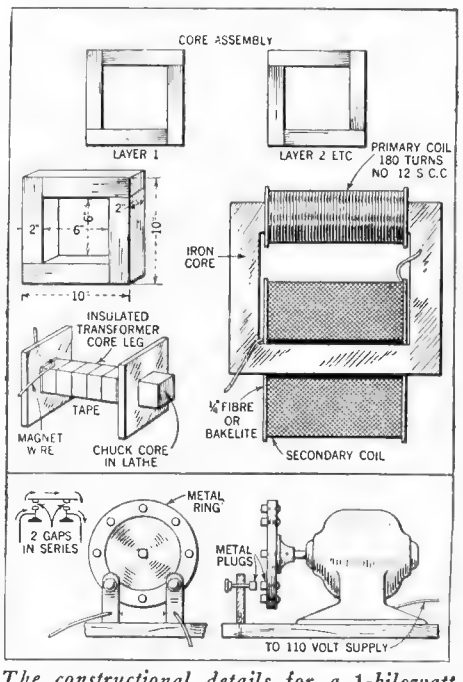
"Stunts" You Can Perform

CARE should be taken not to touch the leads of the 20,000-volt transformer or primary coil, as a burn might result.

Geissler tubes will glow several feet from the coil in operation, when one end of such a tube is held in the hand. Beautiful violet discharges can be formed in a large lamp bulb with a good vacuum. Two small incandescent lamps can be lighted by their filaments, by two persons, each holding one in their hand, with thumb and finger on the brass bases, and touching the base centers together. One person should touch one terminal of the coil.

Another interesting experiment is to have one person stand on an insulated stool, make contact with one hand to a coil electrode, and pour a stream of water

(*Continued on page* 1201)



The constructional details for a 1-kilowatt 20,000-volt transformer are given above. The rotary spark gap is also shown.

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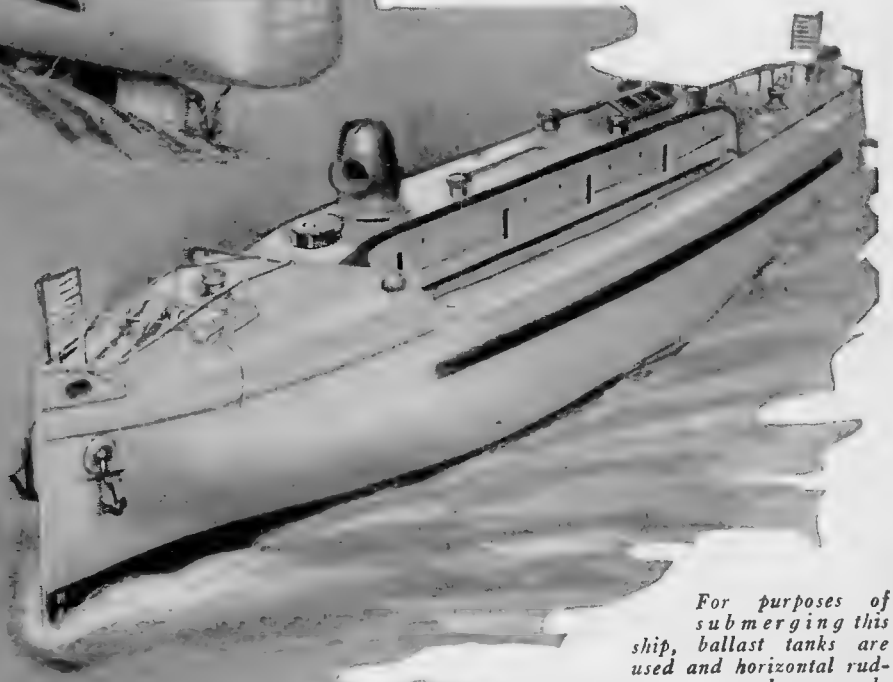
MODEL DEPARTMENT

New Type Submarine Model Wins This Month's Trophy Cup

ON this page are shown the photographs of a model of a new style of submarine as built by Samuel M. Crawford of Bayonne, N. J., for which remarkable piece of work Mr. Crawford received this month's coveted trophy cup.

Every month SCIENCE AND INVENTION Magazine offers a handsome silver cup for the best model submitted each month. The sign on the deck is illuminated from beneath to serve as a beacon for airplanes at night. The model itself is 36 inches long and built almost entirely of metal. (*Rules for Model Department entrants appear on page* 1211.)



The illustration above and the one at the right show two views of the prize-winning model. Note with what care the details have been preserved. The vessel is driven by twin-screws.

For purposes of submerging this ship, ballast tanks are used and horizontal rudders are absent. The vessel can be submerged by allowing water to flow into the tanks.

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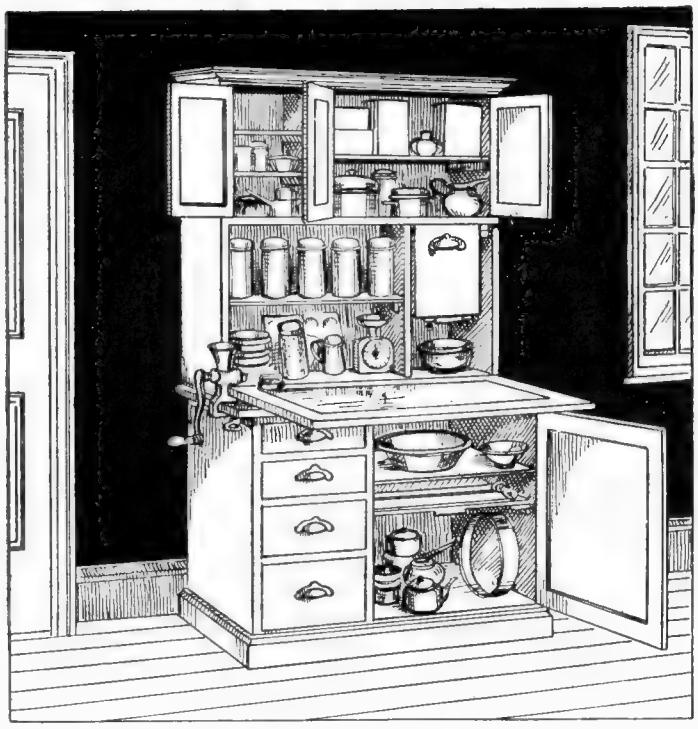
The Constructor

How to Build a Labor and Space-Saving Piece of Furniture Which Will Lessen Household Drudgery

Easily Made Utility Cabinet Provides a Storage Place for Food and Kitchen Utensils



The above illustration shows the completed kitchen cabinet made according to the plans given at the right.

Home-Made Kitchen Cabinet

By J. E. LOVETT

AMONG all the devices for reducing labor in the work of the house, and of promoting cleanliness in the preparation of food, the introduction of the labor and space-saving cabinet takes a very prominent place. Such a cabinet is here shown; it is simple to construct, and not costly when its utility is considered. Good sound pine could be used, but better results would be obtained with a hard wood; oak or birch would be very suitable.

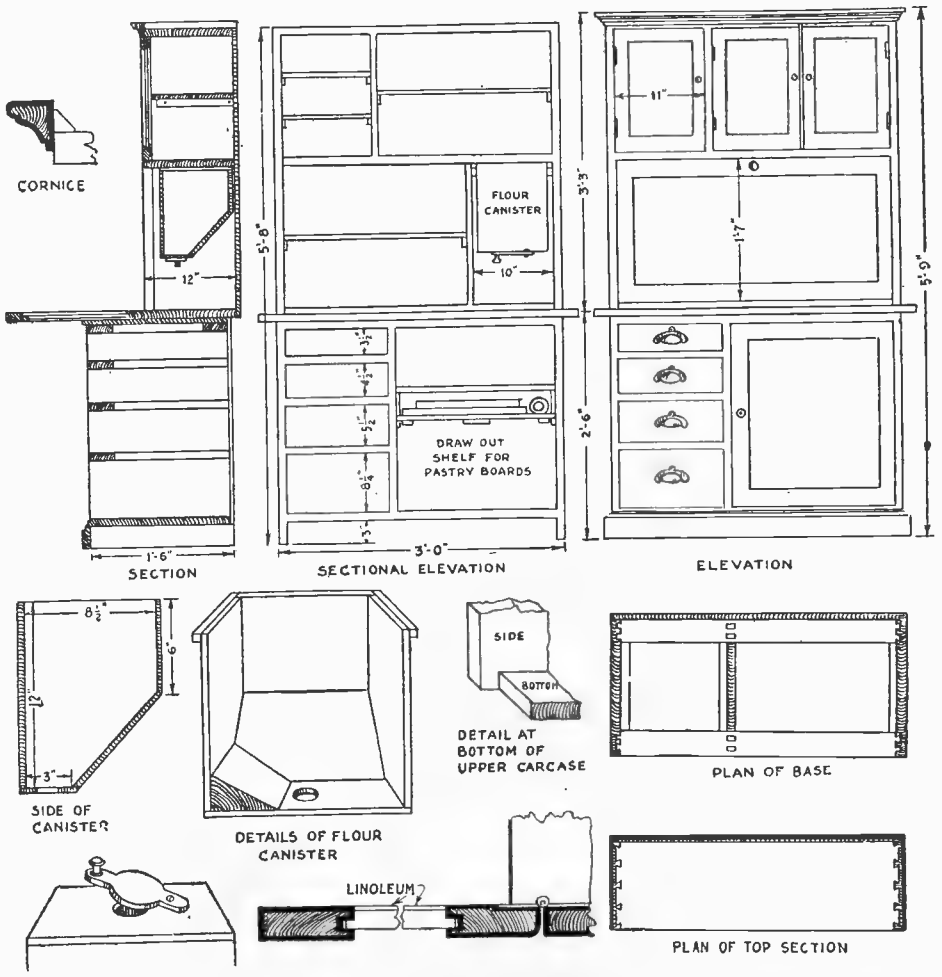
Made in Two Portions

THE cabinet is made in two portions, consisting of lower and upper carcases, each 3 ft. wide, and totaling 5 ft. 9 in. in height. In the lower carcase the right-hand side enclosed with a door is fitted with shelves, one being a drawer-out shelf for pastry boards. The left-hand side is fitted with four drawers; the first and second could be divided as will be found most convenient, and lined with baize, for plate and cutlery respectively, the third could be used for linen, and the bottom drawer could be metal lined and used for cakes and pastry.

The upper carcase is 6 inches narrower than the lower; it is divided by a main shelf, the space under the shelf being enclosed with a hinged flap, which, when opened, forms the working table. Behind this flap on the right-hand side is a flour canister, from which flour may be drawn off as desired by moving a small shutter at the bottom. On the left-hand side a shelf or shelves may be fitted. Above the main shelf there is an upright division and three hinged doors, the space behind being fitted with shelves. The drawings show all the necessary details and dimensions for making the cabinet. Timber ⅞-inch thick should be used for all the principal parts. Start on the lower carcase, preparing the two ends, bottom, and division. The bottom is framed into the ends with mortise and tenon, or dovetail-groove joints, and the division is similarly framed into the bottom. The drawer rails are three inches wide, tenoned into the end and division, and the top rails are four inches wide, dovetailed into the ends and mortised over the division.

Drawer Runners

DRAWER runners 1½ inches wide are fitted behind the drawer and top rails, and if desired they may be grooved for dust boards. The top of the (*Continued on page* 1213)



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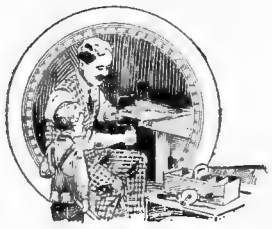
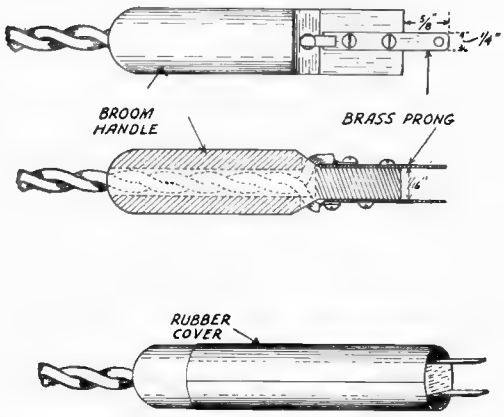
Simple Time and Labor-Saving Devices Which Are Easily Constructed



HOW TO MAKE IT

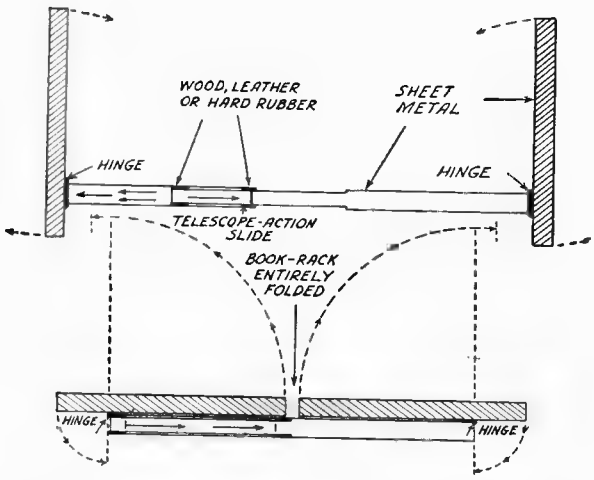
Helpful Hints for the Home and Workshop

Electric Plug



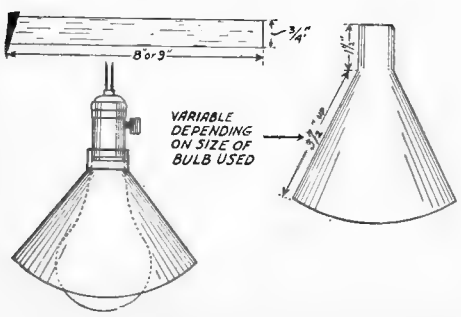
An electric plug can be made with a broom handle cut and drilled as shown above. It should be boiled for about 10 minutes in paraffine, so as to make it moisture-proof. Two brass prongs are made and mounted on the broom handle. A rubber, bakelite or cardboard tube serves as a cover.—Robert J. Williams.

Folding Book Rack



A folding book rack, easily packed and carried with a sliding action which permits the sides to be varied according to the wishes of the user is illustrated above. Sheet metal or wood can be used in its construction. The telescopic slide is an important feature.
—Robert Kerr.

Reflector Lampshade

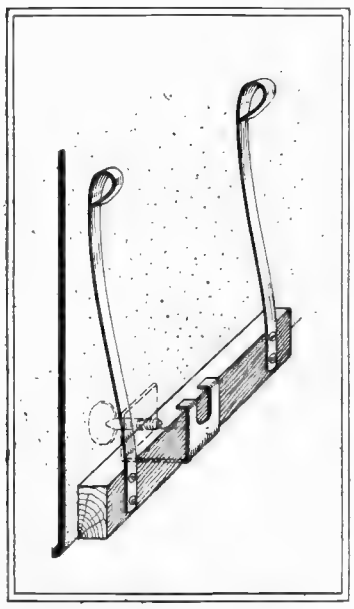


A practical lampshade and reflector can be made from a piece of lead foil and a paper clip. The straight section of the shade is folded so that it laps over the long rectangular piece. — Eugene Weber.

Auto Map Holder

A MAP HOLDER is of great convenience during an automobile trip and will keep such material within easy reach of the driver. The holder consists of a small strip of wood, which is secured by clamps or bolts to the dash. A slight groove is made in its upper side and two small springs taken from an old alarm clock are screwed in place as shown.

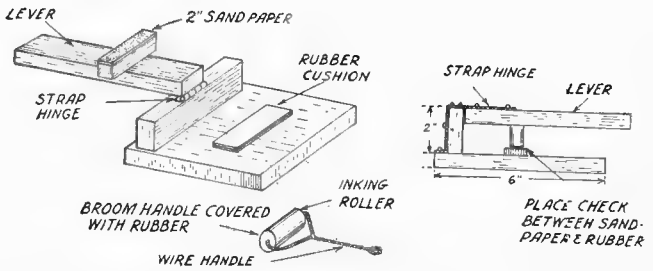
The above photograph shows the completed map holder in use.



Details of the holder are illustrated above. The springs hold the maps against the dash.

The springs hold the maps against the dash and a groove in the wood may be used to prevent the maps from falling. The springs are prepared for use by breaking off a short piece of clock spring and then heating both ends over a flame until red. This makes them soft for working. One end is looped as shown and the other end fastened to the wooden strip. The looped end may be riveted. This looped end forms a convenient handle. The other end is held to the wooden strip and so completes the map holder. This small device which is easily constructed saves much time and annoyance when taking an automobile trip. — *Dr. Ernest Bade.*

Check Protector



Constructional details for a check protector will be found in the above drawing. For the protecting device, No. 2 sandpaper is used. The inking roller consists of a short piece of broom handle covered with rubber. The rubber cushion cut out of an inner tube is glued to the baseboard. To operate the protector, the inking roller is well inked and then rolled over the sandpaper several times. Place the check face up on the rubber cushion, so that the part to be protected is covered by the sandpaper. Press down on lever, which causes sandpaper to emboss and perforate check
—R. J. Williams.

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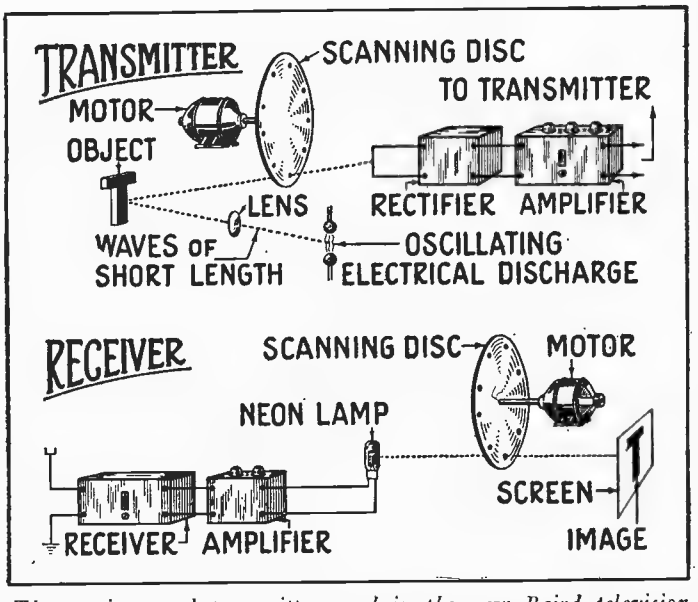
New Radiovision Method

English Inventor Develops New System for Transmitting Images

JOHN L. BAIRD, of London, England, that tireless television experimenter who has many inventions of this nature to his credit, recently obtained a United States patent dealing with a new method for transmitting views or images at a distance, known at the present time as television.

It is generally known that when transmitting images, a substance which changes its electrical resistance or emits an electric current under the action of light is used for the purpose of using the luminous radiation emitted by or reflected from the object. Such a device is familiar to many and known as a photo-electric cell. The electric currents thus produced are transmitted over wires or by radio and a suitable receiver is used for reproducing the object. The present system uses a form of radiant energy of short wavelength for viewing the object.



The receiver and transmitter used in the new Baird television system are shown above. The object is illuminated with waves of short wavelength adjacent to the infra-red.

Illumination by Short Wavelength Radiations

FOR the purpose of vision in the present system, the means for viewing the object consists in projecting upon it electro-magnetic waves of short wavelength adjacent to the infra-red radiation in the spectrum, but of longer wavelength than infra-red rays. The object is explored by a device sensitive to such waves, comprising a tuned oscillating circuit with a detector. A source of visible light is modulated by this device. A spot of light is projected from this source over a screen in synchronism with the exploration of the object. It will be seen that by reason of the different character of the waves used in the present method, that a distinctly different type of receiving apparatus must be employed.

Reflector and Refractor

THE source of visible light may be remote from the modulating device and can be controlled by the wire or radio transmission of the modulating impulses.

It is a known phenomenon that radio waves can be refracted and reflected in a manner similar to visible light waves and are subject to such differences as arise from differences in wavelength. By combining a suitable choice of materials for refractors and reflectors, all the desired effects can be obtained. For example, a metallic body will act as a reflector for long waves, whereas an insulator may be wholly permeable to such waves. By using electro-magnetic waves of very short wavelengths, such as those mentioned previously, the refraction and reflecting effects are similar to those obtained with wavelengths within the visible spectrum.

Transmitter

IN the illustration shown here, the transmitter has been portrayed in simplified form. Radiation from a generator which may consist of two metal spheres across which an oscillating discharge passes, provides waves of the desired length which are projected by means of a lens formed of pitch or other suitable material upon the object. This object, by means of an exploring device or scanning disc, is explored by a wire equivalent to the antenna of a radio receiver, sensitive to the waves referred to previously. This device is electrically connected with an oscillating circuit or it may form a part of this circuit. The oscillating current set up in this circuit is rectified by a rectifier or a detector which may be a crystal, a thermionic valve or a pair of metal spheres between which the sparks pass and due to the oscillating current in the tuned circuit act upon a selenium or other sensitive cell and thereby cause the necessary fluctuating electric current to be set up in the latter. The rectified current is then sent through an amplifier and transmitted to the receiver by the carrier wave of a radio transmitter which is modulated in accordance with the varying current produced by scanning the image.

Receiver

FROM the receiver, the picture signal impulses pass through an amplifier and then to a glow discharge tube, the radiation from which is controlled in accordance with variations in the voltage. This lamp operates in conjunction with a disc running in synchronism and having the same number of holes as that used at the transmitter. A screen is provided whereby a visible image of the object is produced.

Advantages of System

THE construction of the generating device may be such as to emit waves of other lengths than those used in illuminating the object here described. Such undesired waves are eliminated by passing through a medium which filters out or absorbs them. It is apparent that in using the apparatus for penetrating fog and viewing an object at a distance, the fog effectually prevents the passage of the undesired waves. Of course, the same function can be performed by means of a lens which serves to pass short radio waves only. The system can thus be used for transmitting the waves without the risk of detection by the object upon which they are trained. It is obvious that such a method would be invaluable during war. Further, it has been found that the length of the electro-magnetic wave projected through a fog, materially affects the penetrating power. This penetrating power increases as the fourth power of the wavelength in such cases. It will be seen, therefore, that the radio waves are able to penetrate fog more easily than infra-red or the still shorter light waves.

Furthermore, when either light rays or infra-red rays are used in television, it is necessary to receive these waves by a light-sensitive device or a heat-sensitive device. By using short radio waves in television, an ordinary detecting system can be used. Such detectors are much more sensitive than any light-sensitive device. The undesirable heating effects obtained when light rays or infra-red rays are used are eliminated.

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Photographs Over the Air in Forty-Eight Seconds

Picture Apparatus Developed by Westinghouse Engineers is Simple in Construction. Produces Copy of Original Directly on Sensitized Paper

The above photograph shows one of the radio photo receiving sets with an attendant setting the dials for reception.

RADIO DEPARTMENT

New Radio Picture System

A SIMPLE method for transmitting pictures and facsimile messages by radio has been developed by engineers of the Westinghouse Electric & Manufacturing Co. It has been designed with simplicity in mind, so that a skilled operator is not required. The system requires no special preparation of the original and the receiver records the copy directly on sensitized or photographic paper. A picture measuring 5" x 8", either in half-tone or black and white, can be received in forty-eight seconds, and a message at the rate of 630 words per minute over short distances. The resulting prints are of good quality and suitable for newspaper or magazine reproduction and clear messages can be made from typewritten originals.

Optical System

A METHOD wherein a special treatment of the original is necessary, obviously cannot be used where high speed transmission is desired. The solution lies in scanning the original picture or message by means of a beam of light and using the light reflected from its surface. The optical or scanning system used at present allows the size of the scanning spot to be adjusted to the required dimension and the reflected light is collected. The drawing showing transmitter and receiver illustrates clearly the optical system of the picture machine. The source of light is focused first on the diaphragm, to make the size of the spot independent of the size of the source. The reflected light is gathered by a parabolic reflector, part of which is cut away, in order to pass the light, and the remaining part placed close to the picture. Almost all of the reflected light is collected as a parallel beam, and a plane mirror with a small hole for the passage of the illuminating light spot or pencil reflects the parallel beam onto a photo-electric cell. The optical efficiency of this arrangement is surprisingly high.

Scanning

IN the transmitter shown here, which is of the type that must be stopped for reloading after each picture, the picture to be sent is wrapped around the cylinder. The shaft of this cylinder is hollow and has a screw inside which can be locked to the shaft or to the support. A locking nut on the cylinder can be raised or lowered, locking the cylinder with the shaft and screw. If the screw is connected to the shaft, the cylinder rotates with it but remains stationary in a longitudinal position. When the screw is released from the shaft and locked to the support by means of an electro-magnetic clutch, the screw is stationary in respect to the rotating nut and the cylinder begins to advance. In this manner the whole picture surface is gradually exposed to the scanning light beam. The speed of scanning is 56 inches per second, while the speed of the cylinder feed is 1/64 inch per revolution. For most pictures and messages, this picture feed speed was found to be quite satisfactory.

Photo-Electric Cell

THE photo-electric cell used is of the magnesium-caesium type and is filled with argon. Two electrodes are placed within the bulb, one on the inner surface and the other is ring-shaped and in the center. A window is provided for admitting light. The coating will emit electrons at a rate which is proportional to the amount of light absorbed by it. An electron flow takes place to the anode, being accelerated by an external potential obtained from a battery. During their passage the electrons collide with the molecules of the argon gas and ionization occurs. In this manner, the output of the cell is increased many times, yet the proportion between the quantity of light and the output is not destroyed.

Amplifier

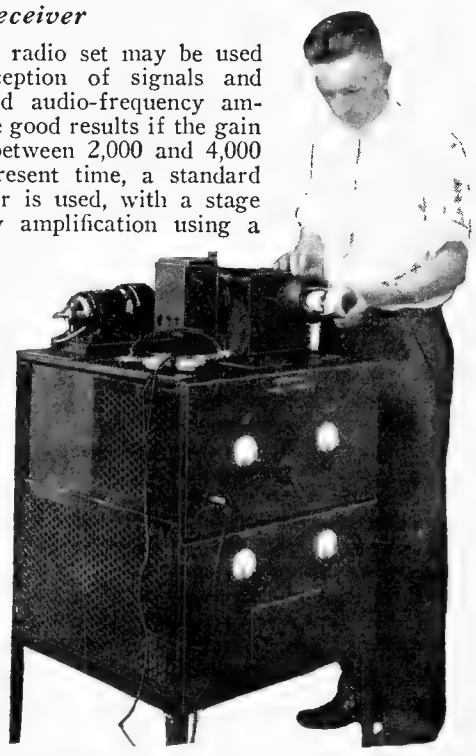
UNDER operating conditions, this cell supplies a current of about 1/20 of a micro-ampere for the white portion of the picture. High amplification is therefore necessary before these small photo-electric currents can be used for transmission. The amplifier employed at present is a three-stage, resistance-coupled affair, using two shield grid tubes in the first and second stages. The voltage output of the third tube is about 40 volts, which is sufficient to operate the modulator of the transmitting station, even over a line of considerable distance.

Receiver

A STANDARD radio set may be used for the reception of signals and transformer-coupled audio-frequency amplification will give good results if the gain is quite uniform between 2,000 and 4,000 cycles. At the present time, a standard short-wave receiver is used, with a stage of radio-frequency amplification using a screen grid tube, detector, and two stages of audio.

Glow Tube

THE glow tube used in connection with the receiver uses a helium glow for recording, which glow is restricted by a mask built directly into the tube. A discharge of 15 milliamperes at 400 volts will blacken sensitized bromide paper. The bromide paper is exposed at working speed to the



The picture transmitter is shown here. An attendant is placing a photograph upon the cylinder preparatory to its transmission.

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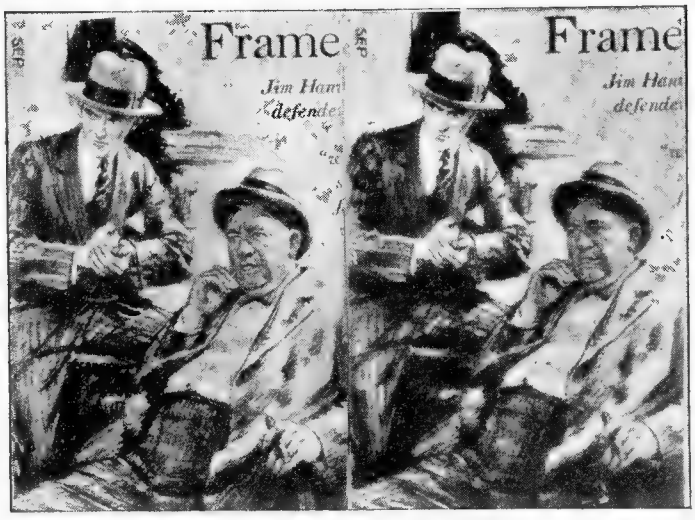
Facsimile Message of 630 Words Sent in One Minute

Efficient Optical Arrangement Developed

glow and then developed in the usual manner.

Glow Tube Control

A VACUUM tube is used for controlling the glow tube. The glow tube is connected in series with the plate voltage supply for the vacuum tube; fluctuations in voltage upon the grid, due to the picture signal, will produce corresponding variations in the glow tube current. If the signal were fed directly from the audio amplifier to the grid of the control tube, a negative picture would result. Unless the picture is to be recorded on a film and prints made afterward, it is necessary to reverse the process. This is done at the receiver rather than at the transmitter, because atmospheric disturbances would be recorded as black spots on a white background. If the reversal is made at the receiver, these disturbances will tend to make the white whiter. Voltage from the receiving set is applied to a push-pull detector using UX-112 tubes, which are so biased as to give practically zero plate current when signals are absent. Any voltage supplied causes a drop in voltage across the plate resistor. This voltage drop is impressed upon the grid of the control tube, decreasing the glow tube current when strong picture signals are received.



Above, at the right, is the original sketch and at the left is an unretouched reproduction of the received copy. In this instance, the picture was transmitted over a short telephone line and a few miles by radio.

Synchronizing Arrangement

A 70-CYCLE tuning fork in a constant temperature box is employed at both the receiver and transmitter. These two forks are so adjusted that there is only one beat between them in twenty seconds or more. Thus, the fork at the receiving end is corrected at every revolution of the picture cylinder by an impulse of a half cycle duration. This impulse is broadcast on the picture channel, but on the margin of the picture, in order to avoid interference. The voltage from the tuning fork which is driven by an oscillator, is amplified and applied to motor slip rings, while most of the energy for driving the motor comes from a direct current source.

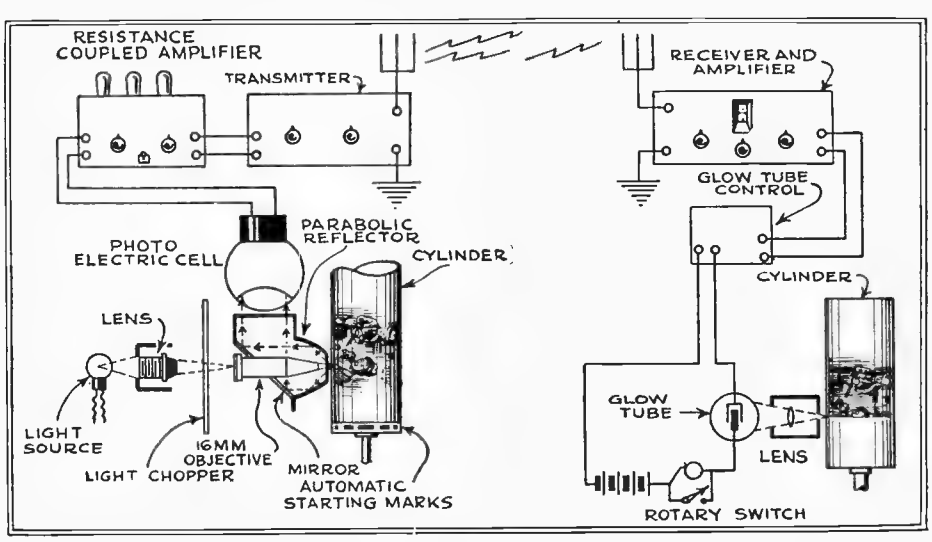
Picture Framing

THE framing of the picture is accomplished by holding the picture to be transmitted on the cylinder with a longitudinal black band. At the end of the cylinder is a narrow white ring. The light spot explores this ring and a continuous signal is transmitted, except when the black band absorbs the light. The glow tube at the receiver flashes whenever the black band occurs, which is seven times each second. At the end of the shaft of the receiving cylinder is an interrupter which breaks the glow tube current for a time interval equal to that required for the transmission of the band. If the interruption takes place at the same time that the flash normally occurs, the light from the glow tube appears steady, showing correct framing. If flashes are seen, framing is easily accomplished by a process equivalent to rotating the motor frame. In the continuous picture transmitting machines the motors run constantly and framing is only required at the beginning of each transmission. When synchronizing and framing is accomplished, the picture starts to pass under the scanning spot of the transmitter. The starting of the receiving cylinder is accomplished automatically.

The receiver is placed in a dark room or adjacent to a developing booth. In illuminated rooms, the cylinder containing the sensitized paper must be in darkness and as may be seen from the accompanying photograph, a cloth sleeve fits over the cylinder. A reproduction of an original and of a received picture made with the new picture transmission system are shown here and give an idea of the excellent results and definition of detail obtained.

Automatic Receiver Starting

WHEN synchronizing has been accomplished and the picture is in frame, it starts to pass under the scanning spot of the transmitter. The receiver cylinder is started automatically. On the front end of the transmitting cylinder a band of white and black spots is engraved and when the picture cylinder is started, this band comes first under the scanning spot. Consequently, the corresponding frequency is produced by the transmitter and is reproduced by the amplifier at the receiving end. This frequency operates a small tuned relay which starts a grid glow tube. The current passes through the grid glow tube and operates a lock-in relay. This completes the circuit to a magnetic clutch which starts the receiving cylinder. The automatic starter does not require any additional equipment at the transmitter or the broadcasting station.



Both the receiving and transmitting ends of the system have been illustrated above. The special optical system is shown. A resistance coupled amplifier is employed at the transmitter.

For an efficient commercial transmitter the intermittent type is not suitable due to the loss of time in reloading. The principle remains the same as that used in the intermittent transmitter described here, but the relative motion of the paper with respect to the scanning light is changed. The reflected light is carried by plain mirrors along the axis to a stationary photo-electric cell. The automatic starting device eliminates the use of any complicated arrangement of signal dispatch for starting the apparatus in motion. Through the use of a simple framing and synchronizing system, the instruments do not require special amplifiers or a separate channel despite the high transmission speed.

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New Reproducers Aid in Better Radio Reproduction

Dynamic Speakers

The Second Part of an Article Dealing with the Features of Various Moving Coil Type Speakers

By PAUL L. WELKER

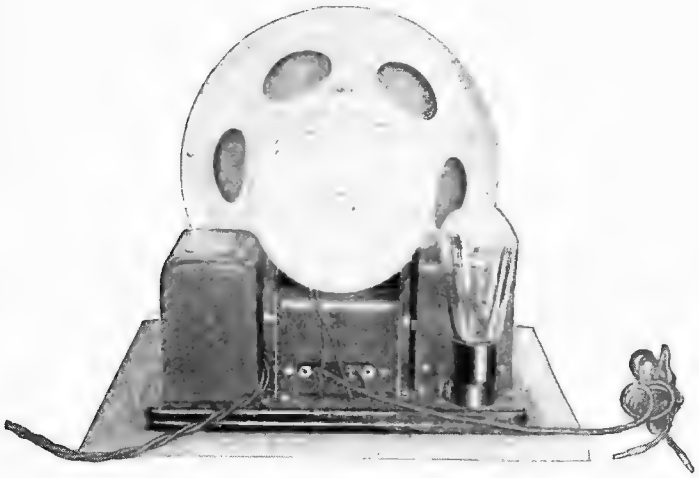

Fig. 1—One of the latest dynamic chassis is shown in the above photo which gives a rear view. Direct current is used for the field supply and is obtained by using a 280-type rectifier tube shown at the right. The output transformer is in the center.

IN the March issue of this magazine, the author described the outstanding features of a number of moving coil type speakers. The theory of operation and construction was presented in quite some detail, so that we will not treat with these in the present article. However, mention was made of a hum neutralizing coil and since many readers were interested, we have prepared an illustration showing the exact position of this coil and the manner in which it is connected.

Hum Neutralizing Coil

AS explained in the previous article, the hum neutralizing coil used on models which are designed for rectified A.C. field excitation, is wound across the center pole and connected in series with the moving coil. The hum neutralizing coil is wound in the opposite direction to the moving coil and picks up the same amount of hum but in opposite phase to that induced in the moving coil by the field. When the field is supplied with full wave rectified A.C., the hum is thus cancelled out. The position of the hum coil is clearly evident in the accompanying drawing.

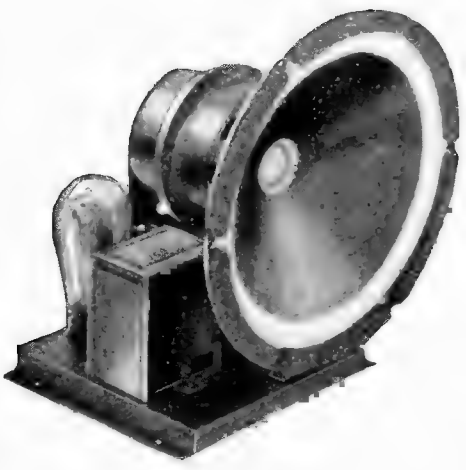

Fig. 2—Another model which also uses a full-wave rectifier is shown here. A universal output transformer is provided.

Many Types of Dynamics Are Now Available

High Voltage Field

WITH two of the models shown in the photographs, a 280-type full-wave rectifier is employed as the speaker field winding is of the high-voltage low-current type. This delivers 120 volts D.C. to the field. The model shown in Fig. 2 uses the high-inductance field coil itself as a choke and so eliminates the usual A.C. hum in the speaker itself. The same manufacturer makes models which have the field coil wound to a resistance of 1,900 ohms, so that they may be connected to a source of direct current such as that obtained from a "B" eliminator or by using the field coil as a choke in the filter circuit of a "B" supply unit. The model shown in Fig. 2 is mounted upon a steel base which also carries the power supply unit and the universal output transformer described below.

Universal Output Transformer

THE speaker mentioned above is equipped with a universal output transformer which has a wide application. This transformer is designed to operate from a push-pull amplifier using two type 171-A, two 250-type tubes, or, two of the new intermediate type power tubes which are soon to be made available. A tap on this transformer is also provided for most efficient operation when one 171 or one 250 is used, while the whole primary winding matches a 210 tube. The transformer has been designed to avoid core saturation, even when using two or more 250 tubes.

Another D.C. Model

FIGS. 1 and 3 shows another dynamic chassis which also uses the filtered output of a 280 full-wave type rectifier for field excitation. The photograph, Fig. 1, shows a rear view of this dynamic chassis. The A.C. transformer is mounted on the left-hand side of the base with input transformer directly below the speaker in the center and the rectifier tube and filter at the right. This model uses an 8-inch cone best seen in Fig. 3.

A 6-Volt A.C. Model

FIG. 5 shows a 6-volt A.C. model which uses a full-wave dry rectifier mounted at the right. The step-down transformer is shown at the left. The power required is only about 35 watts and the cone measures about 6½ inches at its widest part, making a compact yet very efficient unit as our tests have shown.

The necessary output transformer and filter are provided with the speaker, which has a base for mounting directly in a cabinet or on a baffle board.

Music and Speech

SOUNDS, as we know, are merely vibrations in the air or other media. The pitch of the sound is determined by the number of vibrations which the sounding body makes in one second. Generally, the intensity is referred to as loudness, and the quality called timbre.

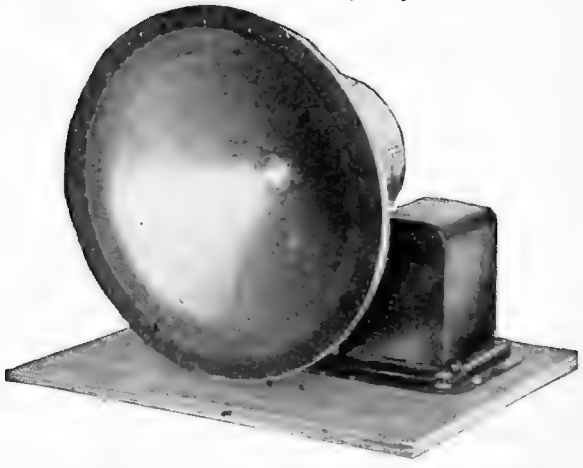

Fig. 3—The above photograph shows a three-quarter view of the moving coil type speaker seen at the top of the page in Fig. 1.

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All musical instruments emit specific sounds or rather vibrations, known as fundamentals. In addition to this, there are overtones or harmonics which are exact multiples of the fundamental note or pitch. Two notes of the same fundamental but played on different instruments may have different overtones missing, and therefore the notes sound different and we are enabled to distinguish between the various musical instruments even though the same note is being played. The piano has 88 fundamentals, each having a group of overtones, and in the reproduction of speech and music it is necessary that all the overtones and fundamentals be reproduced in their original proportions. If this is not done, distortion results.

Loud Speaker Requirements

THEORETICALLY, a loud speaker should be sensitive to or reproduce equally well all frequencies from 16 to 12,000 cycles per second, 16 cycles being the lowest organ note. Obviously a reproducer meeting with the above requirements cannot be obtained at the present time, but we may obtain excellent reproduction with the speakers now available. It has been found that a frequency range of 30 to about 10,000 cycles per second will give almost perfect reproduction of both speech and music. A speaker which reproduces over the range of 30 to 5,000 cycles will give excellent results. Most dynamics are equipped with a filter which cuts off in the neighborhood of 5,000 cycles. This, however, is not detrimental and is done in order to eliminate much of the noise and hissing produced by the receiver itself above the 5,000 cycle range. Further, the best audio frequency transformers on the market at the present time are designed to pass a band of 5 K.C. wide and cut off at 5,000 cycles.

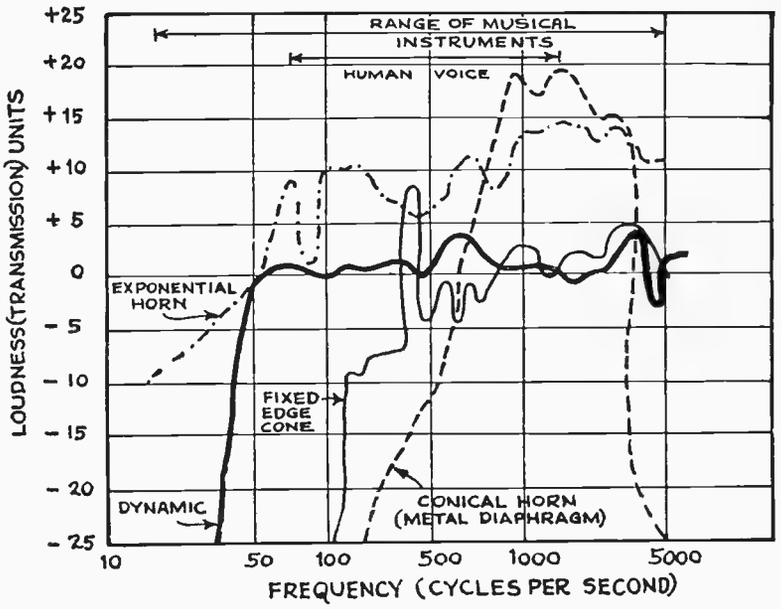

Fig. 4—The above graph shows the response of various types of loud speakers at frequencies up to 5,000 cycles per second, plotted against loudness or transmission units, now known as decibels. The range of musical instruments and that of the human voice is also shown.

A Comparison

BY virtue of their construction, dynamic speakers show excellent response characteristics. Fig. 4 shows response curves of an exponential horn, a fixed edge cone and an old style conical horn with a metal diaphragm compared with the dynamic. The range of musical instruments and the human voice have also been indicated. The response in frequency or cycles per second has been plotted against loudness units. The common horn speaker shows up poorly, due to the many faults in its design. Further, there is a marked falling off in response to the lower frequencies, nor can it reproduce the higher frequencies which is perhaps well, as it will cover up distortion due to tube overloading. The exponential horn, when correctly designed and equipped with a good unit, is far superior and will pass a wide frequency band. A good fixed edge cone shows a response as illustrated with a number of resonance peaks. The impedance of all these types of speakers varies with the frequency.

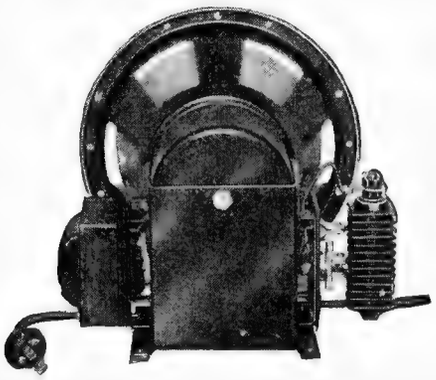

Fig. 5—An excellent dynamic equipped with a transformer and dry rectifier for field excitation is shown in the above paragraph.

The Dynamic

THE moving coil type or dynamic loud speaker offers nearly a pure resistance load at all frequencies and therefore its impedance is almost constant. The resonant frequency of the cone and supporting mechanism of the dynamic is very low and usually around 60 or 50 cycles. This speaker offers a pure resonance load to the amplifier over practically the whole audio frequency range. This type of speaker when mounted on a good baffle and energized from a set of good design having a good audio end is capable of excellent reproduction. The frequency response curve of such a speaker is shown in Fig. 4 by the heavy black line. It has been determined that a variation in amplitude throughout the audio range of less than 5 transmission units is negligible.

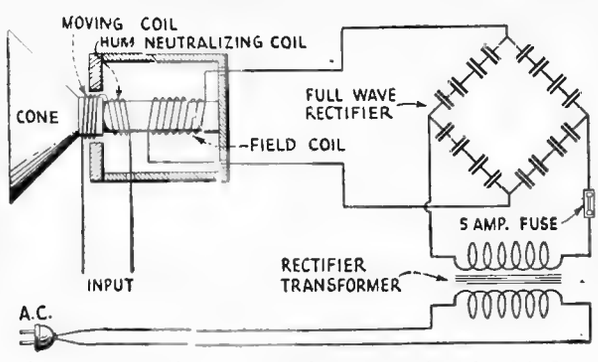

Fig. 6—Some of the dynamics are equipped with hum neutralizing coils which are positioned as shown in the above illustration.

Acoustics

THERE are other factors involved in good reproduction, that is, factors which are not associated with the receiving set, amplifier or speaker. There are a number of differences between the broadcast studio and the listeners' room. An orchestra playing in a studio may sound unnatural if reproduced in a small room, especially one having bare walls and little furniture. Some rooms are badly resonant and good reproduction is impossible even though the finest equipment is used. Further, there is a physiological effect which has to do with excess volume. If the volume is too great, even though fine reproduction is being obtained, it will sound distorted to the listener. This is due to the fact that the ear can be overloaded in a manner similar to a vacuum tube. Often the trouble does not lie with the speaker or amplifier and is due to the listener or the placement of the speaker. Vases and other objects in the room have a tendency to vibrate and ofttimes the speaker is blamed when the trouble really lies in these resonant articles.

Some vacuum tubes are microphonic to such an extent that if the speaker is close enough to the set, a howl will be set up which will not become inaudible again until the set is either retuned, the speaker moved, or the supply to the filaments altered. It has also been found that in some sets, this howl is but of short duration, and only occurs when certain frequencies are reproduced by the speaker. This causes the reproduced sound to periodically become unnatural.

Any attempt to duplicate those conditions found in the broadcasting studio will make for much better reception. Recently, the greatest amount of work in the radio field has been in improving both transmission, and reception. There is no reason why the quality of the home receiver should not be equal or even better than that heard from the monitors of the broadcasting studios.

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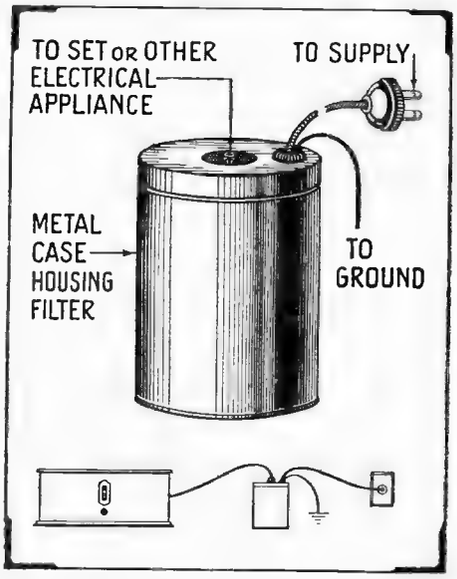
A Monthly Review of the Latest Developed Accessories and Apparatus Which Will Be of Value With Any Receiver

NEW RADIO DEVICES

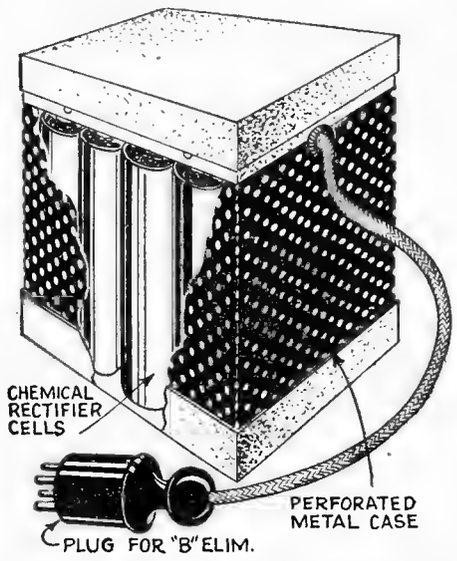
Interference Eliminator

A WESTERN radio manufacturer has recently put on the market an appliance for eliminating man-made interference from the radio receiver. This consists of a filter housed in a black metal case. A length of cord with a plug is provided for connection to the light lines, and a plug is placed on top of the filter for connecting the radio set or other electrical appliances to the filter. A lead also runs from the top of the can and provides for a ground connection. Internally, this lead is joined to the center connection of two condensers placed in series across the line.

Electric receivers will pick up much interference over the line caused by the host of electrical appliances in daily use. Many crashing, crackling and other types of noises coming into the set can be easily eliminated by using the filter as shown. It will also suppress this type of interferences when used in connection with the offending appliances.



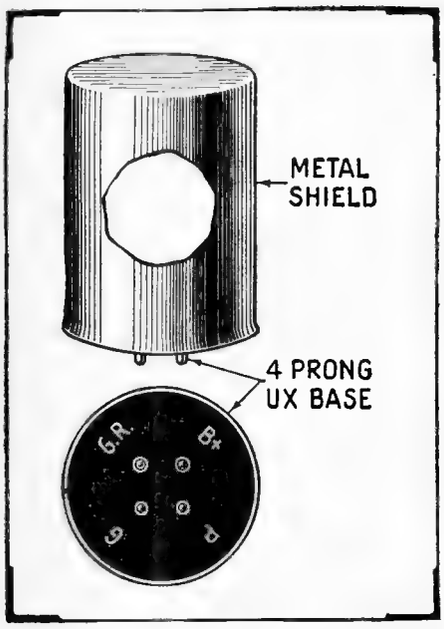
The above illustration shows the interference eliminator and the manner in which it is used with the radio receiver.



One of the two models of the dry chemical rectifier is shown above. A 4-prong plug has been provided for connecting to the eliminator.

Dry "B" Rectifier

A DRY chemical rectifier designed to replace rectifying tubes in all types of "B" eliminators, power packs and electric sets, has been made available by a New York manufacturer. A number of chemical rectifier cells containing a solid, hydroscopic compound capable of self healing action are used. This chemical is non-corrosive and does not creep. The cells are housed in a perforated metal case and a 4 prong plug is provided for insertion in the rectifier tube socket. At the present time two models are available, one giving full-wave rectification from 100 to 1,000 volts which can be used to replace any rectifying tube. The other will replace all gaseous or 280 type filament tubes or the cells in electrolytic rectifiers. The large active surface of the electrodes in the rectifying cells gives a large capacity, such as that obtained with an electrolytic condenser. Consequently, a more effective filter is provided and the eliminator output is well filtered. Due to the large internal capacity of the cells and the nature of the electrolyte, the device holds a considerable charge. The life of the chemical rectifier is practically infinite, as it is self-healing and no chemical reaction takes place.



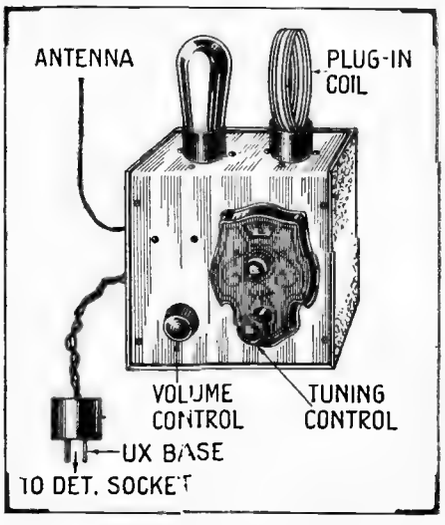
A plug-in radio frequency coil, shielded and equipped with a standard 4-prong UX base has been illustrated above. This is designed to be used with 226-type tubes or others having similar characteristics.

Shielded R.F. Coil

IN order to simplify A.C. set construction, a New York radio concern has developed a new plug-in R.F. coil. The primary is designed so that it is best suited for use with tubes having the characteristics of the 266 type. The coil itself is enclosed in a metal shield and is equipped with a 4 prong UX base which makes it an easy matter to construct an electric receiver. The secondary covers a band of 200 to 550 meters when tuned with a .00035 mf. variable condenser.

Short Wave Converter

FOR those desiring to receive short wave stations on a broadcast receiver, an Ohio radio company is now making a small short wave converter. A number of coils are provided for covering the different short wave bands. The converter can also be used for covering regular broadcast wavelengths, by using a special coil. The output of the converter is fed to the set audio amplifier.



The short wave converter described here is illustrated above. The tube and coils plug in on the top of the cabinet. The tuning and volume control are on the front panel.

Names of manufacturers furnished upon request.

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RADIO ORACLE

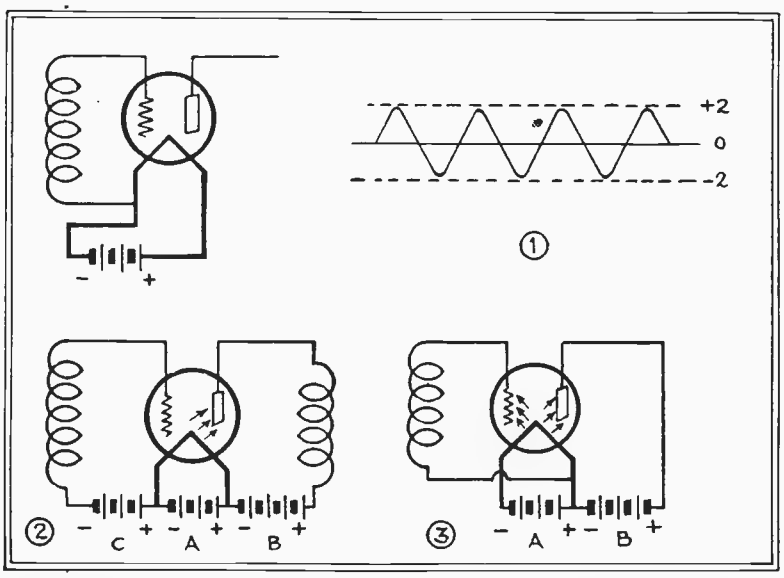
Positive Bias

(704) Hugh Driggs, Thomas, Okla., asks:

Q. 1. What is the effect produced when using no bias or a positive bias on the radio-frequency tubes in a receiver? I have tried a positive bias of small value and can find no different effects than when operating the r. f. tubes with a negative bias.

A. 1. In normal vacuum tube operation, the flow of plate current is accompanied by a flow of electrons which are emitted from the filament and attracted to the positive plate. There is no flow to a point at negative or zero voltage. In Fig. 2 the electrons flow from filament to plate, as shown by the arrows. In a circuit of this sort, the grid is negative and will not extract the electrons in the vicinity. A milliameter placed in the grid and plate circuit will show all the current flowing in the plate circuit and none in the grid circuit. If the grid should be positive, it will attract some of the electrons, as shown by the arrows in Fig. 3.

The curve in Fig. 1 shows a part of the total current on the positive half of the signal. This will not go to the plate but to the grid and will be subtracted from the plate circuit. The rise of current in the plate circuit will be less than the fall of current in this circuit for equal falls and rises of signal voltage. Therefore, plate current rise and fall will not be exactly like the signal voltage rise and fall and distortion will result. For this reason, the grid bias voltage must be sufficiently negative, so that the greatest increase in signal voltage will not cause the grid to become positive and this is accomplished in the manner shown in Fig. 2.



The curve in Fig. 1 shows part of the total current on the positive half of the signal. This will be attracted to the grid. Fig. 2 shows the grid bias sufficiently negative so that the greatest increase in signal voltage will not cause the grid to become positive. The arrow shows the electron flow. Fig. 3 shows what happens when the grid becomes positive. It will attract some of the electrons as shown by the arrows.

Q. 2. In a vacuum tube, the electrons flow from the filament to the plate. How does current flow through the tube when a positive voltage is applied to the plate?

A. 2. The plate of a tube is connected to the positive side of a battery while the filament is connected across the battery or to both the negative and positive sides. The major portion of the filament is therefore at a lower voltage than the plate. It is well known that an electric current will flow from a body of higher potential, through a vacuum, to a body of lower potential when this body is heated above a certain point. If the voltage difference between the two bodies is increased a greater current will flow. The current flow is from plate to filament while the flow of electrons is from the heated filament to the plate in the opposite direction. Electric currents flow from points of positive voltage, to points of negative voltage. Consequently, in any circuit, the electron flow is opposite to the current flow. The electron flow is always toward a positively charged body since the electrons are negative they are attracted to positive or high voltage points.

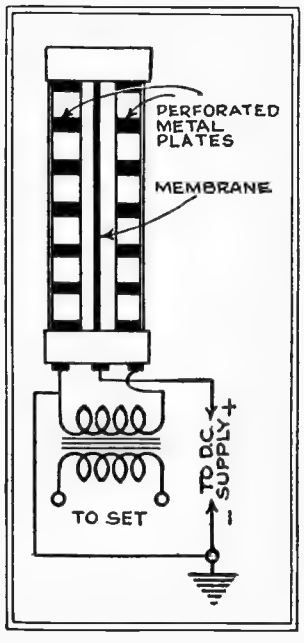
Electrostatic Speaker

(705) Clyde Brooks, Buffalo, New York, asks:

Q. 1. Can you give me some information and possibly publish a diagram showing the latest development in electrostatic speakers, together with the operating theory?

A. 1. The acoustic condenser phenomena has been utilized in electrostatic speakers. A special construction is used which permits the movement of one of the electrodes. Electrostatic microphones and telephones using such construction appeared in the year 1882 for the first time, but have been greatly developed since that period.

One of the latest models illustrated here. A metallic membrane is clamped between two perforated plates separated by insulating rings or gaskets. In addition to supplying alternating voltages to the membrane and plate, it is necessary to provide a direct current voltage, for if this is omitted, the membrane will respond twice to each alternation. The membrane has both positive and negative potentials with relation to the plate unless a d.c. supply is provided. Without the direct current supply, the membrane will oscillate with double the frequency in relation to the alternating current. Under these conditions it will not produce the true frequency. When it is subjected to a d.c. potential, in addition to the alternating current with respect to the plate, its voltage will always be positive in relation to the plate. In operating it will then follow the potential changes accurately. The plates attract the membrane, each pulling equally in opposite directions. The connection to the set and d.c. supply is shown in the diagram with a high voltage, often as high as 700 volts, applied to the membrane. With both plates pulling equally, the membrane is not bent as long as there is no change in potential. However, as soon as this occurs, the tension between one of the plates and the membrane is lessened and the potential between the other plate and the membrane increases. The membrane follows accurately the changes in voltage fed from the receiver and as there is an exact balancing of impulses no overtones result. The metallic membrane is of special construction and is stretched tightly between the two plates.



A cross-sectional view of an electrostatic speaker has been illustrated above. A tightly stretched membrane is interposed between two perforated metal plates.

Coils for Super

(706) L. C. Elledge, Knoxville, Iowa, writes:

Q. 1. Can you give me the necessary data for winding the oscillator and antenna coupler coils for the Hayden De Luxe Super with No. 24 D.C.C. wire on a 2-inch tube to be tuned by a .0005 mf. variable condenser?

A. 1. The oscillator coil should have a primary of 38 turns and a secondary of 38 turns. The pick-up coil should consist of ten turns of wire. The antenna coupler will have a secondary of 76 turns and the number of turns in the primary will depend upon the length of the antenna used with the set. When using a short antenna about one-half that number of secondary turns should be used on the primary, and when using a long antenna about one-sixth of the secondary turns.

Loop Data

(707) Lawrence Vender, Barnegat, N. J., writes:

Q. 1. I have a loop frame measuring approximately 12 in. by 12 in. Can you give me winding data for a loop to be used with a .0005 mf. condenser with wire space about ¼ in.?

A. 1. A loop 1 ft. square has an area of 144 sq. in. and you will need approximately 21 turns spaced ¼ in. apart for covering the broadcast band working with a .0005 mf. variable condenser.

Q. 2. What are the advantages of this type of antenna?

A. 2. The principal advantage of a loop is that it greatly reduces the effect of atmospherics and any strays. Strays appear to be due to varying differences of potential between the earth and the space above it. Such variations of potential readily effect a flat top antenna, because this antenna forms one plate of a condenser, with the earth as the other plate. The loop antenna, however, is not connected to the earth and therefore is not affected by any change of potential with reference to the earth. Furthermore, the loop antenna has directional characteristics.

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A Monthly Fun Page for Those Who Enjoy a Laugh

Scientific Humor

Original Jokes for Our Readers by Our Readers

SALES APPEAL

"This new phonograph needle will outwear any other needle made."

"Well, that's a good talking point."

—*Gleason Pease.*

SOLILOQUY OF A MODERN PHILOSOPHER

"It makes me laugh when I hear them say that the dog is intelligent. Place before the dog a piece of meat and a hundred dollar bill. What will he take? The meat. Can there be a greater idiot than this?"

—*L. Lansberg.*

(ANSWER: Yes, the nut who puts the $100 before the dog.—EDITOR.)

(OF) COURSE FLUID

A certain neighbor asked an inspiring young vocalist if his neighbor artist did not possess a fine liquid voice. His reply was:

"I think so. I hear her straining it every night."—*Joseph Romick.*

HOW MEDIUMS WORK

"Spirit," murmured the medium, "Are you there? If so, rap once. If not, twice." —*J. Granes.*

A DIE(N)ING ROOM

"Why do they call these dentists' offices dental parlors?" asked Smith of his friend.

"Why, parlor is the old-fashioned name for drawing room."—*Wilbur Alexander.*

First Prize

SCHIST IS NOT GNEISS

They were sitting by the seaside on a rock.

"Oh, Professor," she said, "What kind of rock is this?"

"It is Gneiss," the Professor replied.

"I think so, too," she said, "But what kind is it?"—*David Ferris Kirby.*

EUREKA! ! !

SHE: "Why do the leaves fall in autumn?"

HE: "Because they are too heavy to float."

—*Stanley Stanbery.*

ALL jokes published here are paid for at a rate of $1.00 each; $3.00 is paid for the best joke submitted each month.

Jokes must have a scientific strain and should be original.

Write each joke on a separate sheet of paper and add your name and address to each.

Unavailable material cannot be returned.

WORMED AWAY

LITTLE GIRL: "What do you think, auntie! There's something running across the bathroom floor without legs!"

AUNTIE: "Good gracious, child, what is it?"

LITTLE GIRL: "Water, auntie."—*Paul Harvey.*

OUT OF THE VOID

TOM: "Does your fiancée have much to say?"

DICK: "No, but that doesn't keep her from talking."—*Wilbur Alexander.*

THIS IS THE END

PEARL: "Could you suggest something suitable for a girl friend's birthday?"

CLERK: "How about these book ends?"

PEARL: "Just the thing! She always reads the ends before she does the beginnings.—*Mrs. Lester C. Kiehl.*

NO—IT CUTS HOLES IN CLOUDS

AVIATOR: "What did you ask lady?"

LADY: "Is that big fan in front to keep the passengers cool?"—*Leslie F. Carpenter.*

WHAT COUNTERBALANCES LIQUOR

MR. A: "Notice that man yonder trying to walk, he seems sort of wobbly."

MRS. A: (A dietician) "Yes, he has no doubt disregarded his balanced diet." — *T. Emory Hedge.*

LAY FOREVER

FARMER: "What would you suggest feeding my chickens to make them lay?"

CHEMIST: "Cyanide."—*J. L. Ober.*

SCIENTY SIMON SCIENTIST

GEE!-- THE MOON LOOKS MIGHTY BIG-TO-NIGHT!
BY GOLLY!-- OUR OLD SATELLITE SEEMS TO BE SHRINKING IN SIZE!-- IT'S A WHOLE LOT SMALLER THAN IT WAS EARLIER THIS EVENING!
NOW SHE'S SETTING!- AND LOOK AT HER SIZE, WILLYA!- I WONDER WHY SHE LOOKS SO BIG NOW?
W. LEMKIN
SCIENCE LESSON NO 29
BOTH THE SUN AND THE MOON, WHEN CLOSE TO THE HORIZON, APPEAR TO BE CONSIDERABLY ENLARGED. THIS IS LARGELY AN OPTICAL ILLUSION, PRODUCED BY THE CONTRAST WITH OBJECTS SUCH AS BUILDINGS AND TREES WHICH CAN BE OBSERVED IN THE SAME FIELD OF VISION. WHEN, HOWEVER, YOU VIEW THE HEAVENLY BODY THROUGH A TUBE THE ILLUSION DISAPPEARS BECAUSE COMPARISON IS PREVENTED THICKER ATMOSPHERIC BELT AT HORIZON ALSO MAKES A DIFFERENCE.

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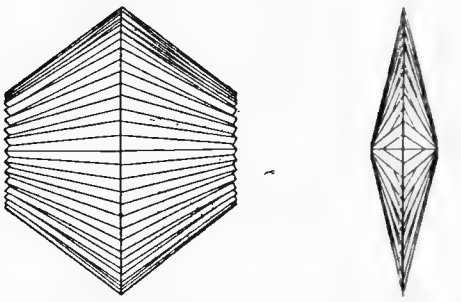
LATEST PATENTS

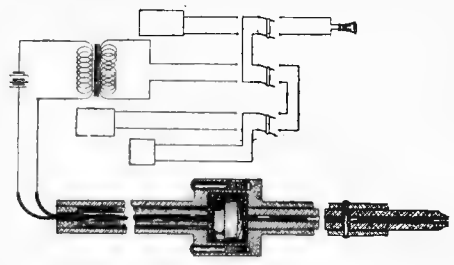
Sound Reproducer



No. 1,688,730, issued to Joseph Archibald Mears. This invention deals particularly with self-supporting diaphragms comprising a pair of hollow cones with their surfaces fluted and bases adjacent, as shown above. A means is provided for adjusting the distance between the apexes, thereby varying the size of the sound chamber which they enclose. The tension on both cone areas may be changed, so as to select values which will give the most pleasing sound reproduction. The process of assembly of the diaphragm is simple and it is readily unfolded or folded for shipment. In one form of the speaker, only one of the cones is plaited.

Vibrometer

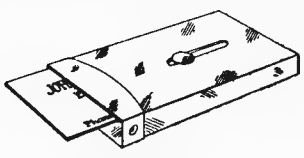
No. 1,686,138, issued to Orin E. Marvel. The device shown comprises a sound transmitter and microphone with a soft disc between the transmitter and the housing. A movable element is supported by the housing and adapted to contact with an external vi-



brating body to transmit the vibrations to the electric transmitter. Small sounds are rendered distinctly audible by this instrument.. D.P.D.T. switches are provided for connecting visual indicators to the transmitter. An induction coil may be connected to one indicator and an audio oscillator to the second.

Card Case

No. 1,697,366, issued to Raymond J. Opfergelt. The case comprises a body having one end open and a removable cover closing the end and provided with a card discharge slot. There is a movable plate within the case and an operating button which works a spring lever ejecting the card outwardly through the cover slot. A spacing strip permits successive cards to be engaged.



Notice to Readers:

These illustrated and described devices have recently been issued patent protection but are not as yet, to our knowledge, available on the market. We regret to advise that it is impossible to supply the names and addresses of inventors of the devices to any of our readers. The only records available, and they are at the Patent Office at Washington, D. C., give only the addresses of the inventors at the time of application for a patent. Many months have elapsed since that time, and those records are necessarily inaccurate. Therefore, kindly do not request such information, as it is practically impossible to obtain up-to-date addresses.

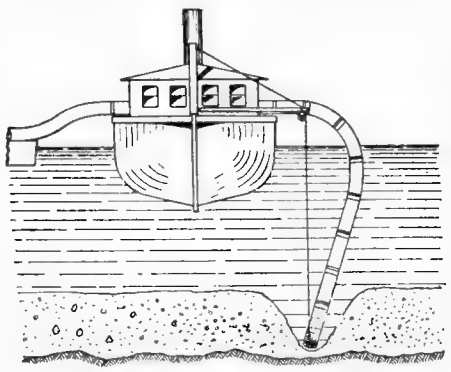
Mooring Means for Airships

No. 1,686,806, issued to Ralph P. Fox. This invention provides a means for mooring an airship of the dirigible type to a mast or plurality of masts. Cables carried by the craft pass through the masts to their base. The nose portion may be secured to a mast

with a second mast positioned so that it may be engaged by a cable extending from either side of the airship. An intermediate structure is provided which permits access to the interior of the ship when moored in the manner indicated. The vessel may come into position on either side of the rear mast as circumstances and wind condition may determine. This mast is forward of the stern and rudder construction, so that danger of injury to these parts may be avoided.

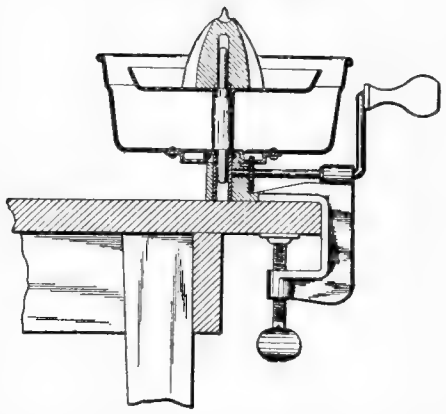
Metallic-Value Recoverer

No. 1,688,109, issued to Fred Forrest Berry. The device shown here is adapted to convey sand and gravel and is especially useful in raising detritus carrying mineral values from the beds of bodies of water. A conduit having a number of passages is provided. Liquid is discharged under pressure



from all except one of the passages which is used for the intake. Mechanical fingers are mounted at the mouth of the intake and oscillate transversely across it. A head is provided for the conduit having an intake for the suction passage with discharge passages adjacently mounted. The moving fingers prevent solids from lodging in the intake tube. Through the violent agitation of matter around the intake head, the latter digs itself into the deposit and water issuing forth prevents clogging around the head.

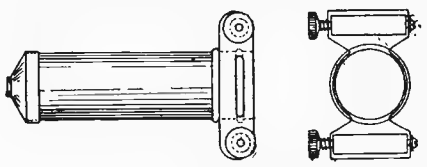
Juice Extractor



No. 1,697,618, issued to Charles Perkins Strite and Arvid Nordgren. By means of this device juice can be extracted from citrous fruits. The pulp and seeds of the fruits are collected in a strainer and the juice runs into a receptacle. A handle is provided which turns the juice extractor. The device can be taken apart easily for cleaning and is simple in construction, costing little to manufacture.

Image Producer

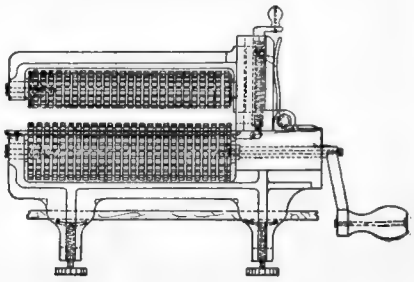
No. 1,697,382, issued to Ernst Paul Burkard. This invention provides a kaleidoscopic or picture viewing apparatus, and consists of a film attached to the end of a tube for viewing pictures applied to the film or paper strip. The tube may either be fitted with a magnifying lens for enlarging or with



mirrors for producing kaleidoscopic effects. In this case the film carrier can be adapted for rotary adjustment on the tube. A frame is provided which makes it possible to hold two films at right angles, so that two pictures can be superimposed across the tube opening.

Meat Tenderer

No. 1,678,699, issued to Herman S. Johns. This machine provides a pair of spaced grinding rollers. One of the rollers is supported yieldingly. The rollers are designed to operate against the meat with a beating effect. The space between the rollers can be adjusted and a motor can be used for rotating with an automatic switch for breaking the circuit should the machine become clogged. The switch is actuated by the yielding movements of the roller referred to above. The machine can also be operated manually and in this case a crank is provided as shown below.



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THE ORACLE

The "Oracle" is for the sole benefit of all scientific students. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink; no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 50 cents is made for each question. If the questions entail considerable research work or intricate calculations, a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

Action of Sunlight on Milk

(2303) Chas. Springer, Phila., Pa., asks:

Q. 1. A small notice recently appeared in the daily press to the effect that milk should be kept in the dark. Is there any truth to this statement?

A. 1. According to recent experiments made by the Bureau of Dairy Industry, of the Department of Agriculture, milk when exposed to sunlight quickly develops an odor and its taste is affected. Light acts as a catalytic agent and causes oxidation more quickly than if the milk were kept in the dark. Tests were made on a series of duplicate samples of milk, one set being exposed to daylight and the other kept in the dark. Those placed in the dark developed no disagreeable odors or flavors during a period of seven to nine days when kept near freezing temperature. The samples kept in the light at the same temperature developed an odor similar to linseed oil and the flavor was also affected in a period of twenty to forty-eight hours of which eight to twenty-six hours were daylight. During the tests, the samples were never exposed to direct sunlight but were placed in a diffused north light. Indications are, therefore, that milk should not be kept in or exposed to any sort of daylight or to the direct rays of the sun.

Carbonated Beverages

(2304) J. B. Holland, Portland, Ore., writes:

Q. 1. I am considering carbonating beer with liquid carbonic acid gas. Can you give me some information along these lines. After corking the bottles would it take very long for the foam to be created so that the beverage could be consumed? How can the liquid be made to hold its gas? What would be the highest temperature at which the beverage could hold its gas until bottled? Would the beverage have to be agitated when charging? What is the weight of the liquid gas? Is liquid gas best for this purpose?

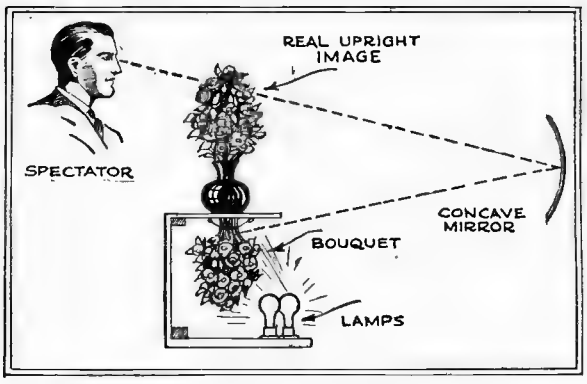
A. 1. Relative to the production of carbonated beer, we would advise that liquid carbonic acid would do little or nothing more than gas at fairly good pressure. The liquid carbon dioxide would be very rapidly converted into gas and bubbling upwards would escape into the air unless the bottle were quickly corked. Treating the liquid in an open vessel would be no better than bubbling gas through it. The only way to make the liquid "hold its gas" would be to cool it well below zero degrees F. The quantity to be used if you cork the bottle instantly would be dependent upon the thickness of the glass and the strength of the stopper or cap. A pint of this liquid weighs a little less than 1 lb. If you are charging with gas, agitation should be used to some extent, but not too much. Open vessel charging with liquid would involve losing a great quantity of it and the loss would be greater as the time increased. We think that liquid gas would answer your purpose, if the entire operation was done in a tightly closed apparatus, then it would be quite practical but probably more expensive than charging with gas. No heat would be required to start the gas "working," as you call it. To secure a lasting foam some mucilaginous substance, such as gum arabic, may be added in solution with water. It is our opinion that gas or sparklet charging will be more practical than simple liquid charging. You might experiment with "dry ice," solid carbon dioxide, but it will be expensive.

Phantom Bouquet

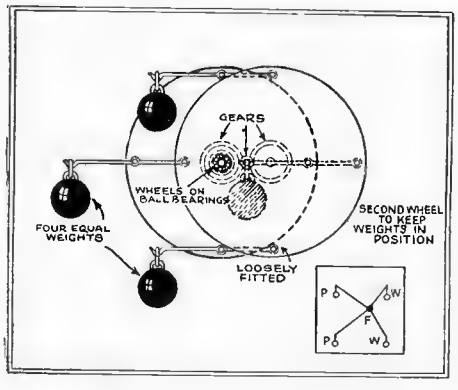
(2305) L. S. Larriman, Oakland, Calif., asks:

A. 1. Can you tell me how I may duplicate a most interesting illusion that I saw recently in a store window? This was an empty vase which appeared to contain a bouquet when viewed directly from the front. If one moved, the illusion immediately disappeared and the vase appeared to be empty.

A. 1. On this page you will find an illustration showing how the phantom bouquet illusion can be duplicated. A bunch of flowers is placed in an inverted position in a box or behind a shield with lamps arranged within the box one on either side of the bouquet. The vase is placed on top of the box directly above the bouquet as shown. The image of the bouquet is projected into the air by means of a concave mirror. This mirror is so arranged that the prolongation of its axis will bisect the angle formed by lines drawn from the top of the vase and the upper part of the suspended bouquet. It is removed from the bouquet and vase, a distance equal to its radius of curvature. When the proper adjustment has been reached, a real image of the bouquet appears in the air over the vase. It is necessary for the spectator to be in a line with the vase and mirror.



The above illustration shows how the optical illusion of a phantom bouquet can be produced.



The above machine is an attempt to produce a perpetual motion mechanism. In the small diagram, F is the fulcrum, P and P descending, and W and W ascending weights.

Perpetual Motion

(2306) H. W. Staniejko, Jr., Chicago, Illinois, writes:

Q. 1. SCIENCE AND INVENTION has been offering a prize award to anyone constructing a perpetual motion machine in accordance with the contest rules. I have an idea for such a machine and am enclosing plans. It works on the lever principle, four weights are mounted on a wheel on hooks, and a second wheel is geared with the first, this is used only to keep the hooks in a horizontal position. The weights on the left are always further from the fulcrum, which in this case is the center of the first wheel, than the weights on the right side. As soon as one weight comes down, another is brought to the left side and the action is constantly repeated.

A. 1. We have produced here the querist's diagram which shows the perpetual motion system he proposes. This idea is not at all new and machines of this kind are listed among the earliest attempts to solve this riddle. The first of these in which was proposed a similar system was conceived by Willars de Honccort, a thirteenth century architect. Information concerning his perpetual motion machine is preserved in a book, "A Sketch Book," by him, in the Ecole des Chartes, in Paris.

In the system employing a wheel with weights on movable levers, only a certain number of weights have the advantage while all the others are being made to ascend. The number of weights could be increased indefinitely, but the number of ascending weights would still be greater than the number of descending weights. The advantage which a few of the weights have by virtue of the leverage pulling downward is always counterbalanced by an increased number of weights being drawn upward and being acted upon by the force of gravity. The direction of the force of gravity is toward the center of the earth, and not in the direction of motion of the wheel, except on the extreme right side.

Omitting friction, the potential energy of a descending body at any point is the perpendicular distance it has to descend multiplied by its weight. Notwithstanding what its course may be from an elevated point to a lower point, the energy accumulated in its descent is still the product of the perpendicular distance and the weight. In your device it is apparent that every weight is brought back by some force from the lowest point it reaches to the same elevation from which it started to descend. The perpendicular ascent is therefore equal to the perpendicular descent. The ascending weights and descending weights are of course the same. Therefore, the product of the weight and the perpendicular distance of descent is exactly equal to the product of the weight and the perpendicular distance of ascent. Hence, there is an exact balance of energies and no motion will result. Any motion imparted by an external force will, if the moving force be withdrawn, soon be overcome by unavoidable friction and a state of rest follows. There can be no doubt that any attempt to attain perpetual motion by means of wheels, weights, levers, and the force of gravity, must result in a complete failure. The idea itself is wholly and physically impossible.

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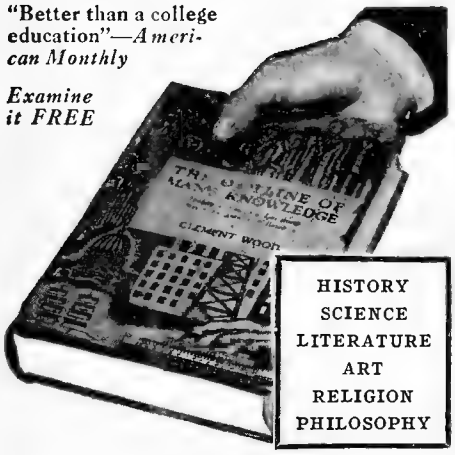

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Woman the Dominant Sex

By Robert Kingman, M.D., F.A.C.P.

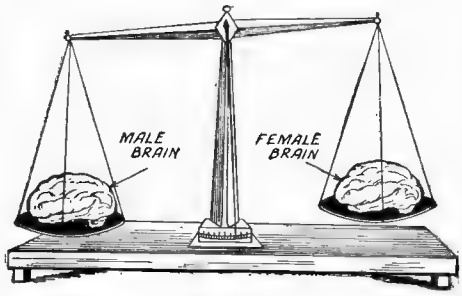
(*Continued from page* 1143)

the male is followed by loss of muscular tissue and diminution of energy, and to an over-development of fatty tissue that shows in rounded contours typical of the female body. We call such individuals eunuchs. Extirpation of corresponding glands in the female produces opposite results—decrease in adipose tissue, and an increase in energy and muscular strength—that is, increased development along the very two lines in which the average woman is inferior to the average man.

The problem of breeding a race of women a hundred per cent dominant would seem to be solved. But, unfortunately, women of this sort are by no means popular with the opposite sex, and they are known by a variety of uncomplimentary names. What is wanted is a method that will increase energy and muscle in women without spoiling the attractiveness of sex that should be in evidence between the ages of puberty and the climacteric. In infancy and old age, reversal or absence of sex does not shock the sensibilities of the opposite sex as it does in the prime of life.

In the first months of life, apart from the rudimentary and useless sex organs, there is little to differentiate the male child from the female.

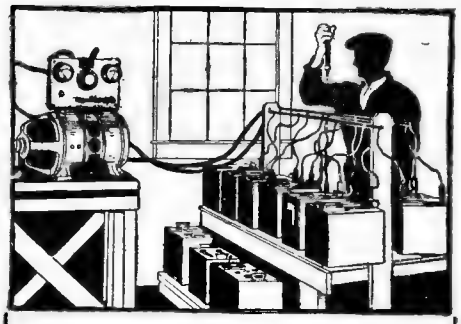
With all these facts in mind, students of genetics are continually experimenting with animal and vegetable forms of life along the lines of sex determination and sex improvement. That they may soon devise methods for breeding out woman's in-



Figures have often been compiled to indicate that the male brain is heavier than the female brain, and from this standpoint alone, the greater intelligence of man is shown.

Actually, there is no difference in brain-weight when the brains are from individuals whose height and weight are the same.

feriority in energy and muscle, without destroying her charm or reversing her sex, is quite within the bounds of possibility. When they do so, let man tremble for his prestige. The gentler sex will be the dominant sex as a matter of fact and not as a matter of courtesy.



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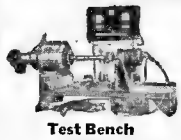
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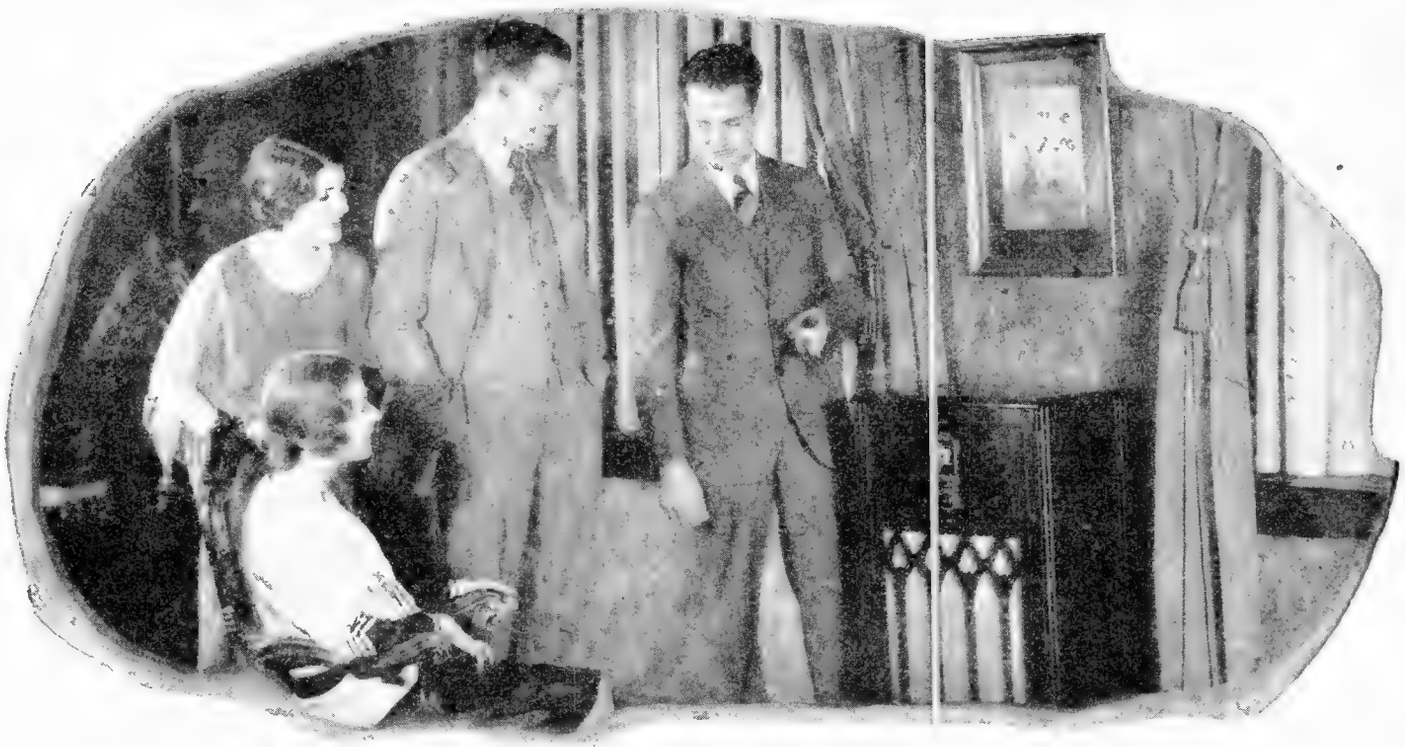

They Could Hardly Believe Their Own Ears — when I Switched to *Ground Wave Reception!*

"IT'S no use trying to listen in tonight," said Bill as I took his hat. "Jane and I tried to get reception during dinner but all we got was static. It's usually this way—just the night they broadcast Paul Whitman's band or some other good program it's spoiled by howls and fading. Why own a radio at all?" he ended up disgustedly.

"Perhaps my set will do a little better," I suggested. I had a surprise in store for him!

"He looked doubtful as I turned on the set switch. I had left my old aerial antenna attached on purpose and soon the room was filled with an ear-splitting excuse for music. Manipulation of the dials only served to make it worse or to choke down reception until it was hardly audible. Occasionally it faded out altogether and I could picture the roof aerial swaying helplessly in the strong wind. Then the jumble and howls would start up again until my wife finally shouted above the din, "Turn that thing off—it's terrible!"

"Satisfied, I laughed and disconnecting the old aerial and ground wires, I then attached the lead-in wires of my new underground antenna, which I had installed just before dinner. "Now listen!" I commanded.

The Thrilling Test

"As though by magic, the sweet high notes of violins, the stirring sobbing of saxophones, the clear pure notes of a clarinet brought Bill to his feet! Jane looked dumbfounded. Even my wife, who had not paid much attention to my preliminary tests, was amazed. "What did you do to it?" she demanded. "I think he bewitched it." Jane accused. The music went on, clear and strong, with only a long moan or slight jumble now and then to remind us of the storm raging outside. The static was so greatly reduced that we hardly noticed it. The important thing was—we were getting one of the year's best programs with scarcely any trouble on a wild, stormy night.

"You see," I explained later to Bill, "I buried my new underground aerial about two feet below the ground, where wind and storms can't affect it so easily. It has certainly been proved tonight that radio waves are just as strong in the ground as they are in the air. They call this thing "Subwave-Aerial" and it's insulated some way to keep out interference and noise. It's combined with a scientific ground so I'm sure now that I have the correct ground connection. And all this isn't costing me any more than my old aerial antenna that I've nearly broken my neck repairing after wind storms like this. And last but not least," I finished triumphantly, "I'll never need to touch it again. It's guaranteed for 25 years."

"Hardly necessary to say that Bill went home with the name and address of the Subwave-Aerial manufacturers in his pocket."

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At 15 minutes to six we got WCCO, St. Paul, Minnesota. It came in loud and clear at 27 on the dial. There was not the slightest interference from the 60,000 volt power transmission line only 50 feet away. At 20 minutes after six, we got Toronto, first on one set and then the other. We plainly heard the program, which was being sponsored by a Spartan Radio dealer.

It was impossible to get reception at all with an overhead aerial under the same conditions.

Yours truly,
F. Bennett Smith,
Harry R. Jackson.

Test It Yourself—Free!

The above story illustrates the results for which the designers of the Subwave Aerial struggled for months. At last, enthusiastic reports such as this from Radio Experts reproduced here, proved that they had succeeded. Now you have a chance to prove the merits of this great new radio development for yourself. Try, if possible, to pick a night when static is bad and make the thrilling test. It's fun! And if you are not more than pleased with Subwave-Aerial, the test won't cost you a cent. We feel safe in saying, however, that once you've heard the amazing difference in reception and realize the wonderful convenience of this modern combined antenna and ground, you'll wonder how you ever put up with the old-fashioned, dangerous, inefficient methods. Be sure to send at once for all the interesting details on the development of Subwave-Aerial. It's the newest, most thrilling thing in the romantic world of radio! Use the coupon below. Fill it in and mail it NOW!

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This Spider Lives Under Water

By Dr. Ernest Bade, Ph. D.

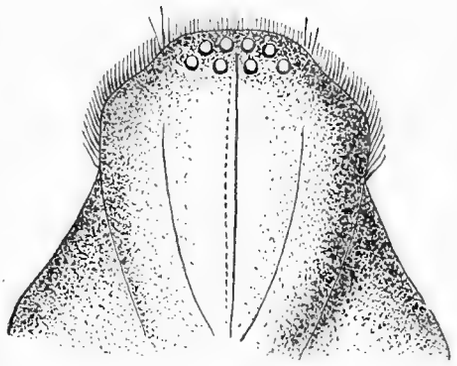
(*Continued from page* 1150)

pletely filled with air, the spider descends and enters its home from the lower open end. Here it remains, resting and passing its time. It does not build any nets with which to catch its prey. When it is hungry it may wait just at the entrance to its chamber until some animal, a water insect, tadpole, small fish, or any other creature passes near. Then the spider darts out into the water and grasps its prey and returns with it to the chamber, where it is consumed. At times the water spider may return to the surface to hunt.

The males and the females, at the time of mating, which may take place either in the spring or in the fall, live in individual diving bells which are built closely together. In this particular case the male is the larger animal, the female being small. This is contrary to the usual procedure, the males being generally the smaller. The diving bell that the male builds is small and, at the same time the male, at times, builds a covered walk from his bell to that of the female. During the period of mating the creatures are irritable and often fight among themselves, when one or the other attempts to enter his mate's nest. After mating, the pair live in harmony, another contrast, for other spider females often eat their husbands. The reason for this peace in union is found in the superior size and strength of the male.

The eggs are deposited in small air bubbles attached to some plant near the home of the female. These eggs are carefully watched and, at the end of about 45 days, the young diving spiders emerge. The young usually begin to build their diving bell at once after they have returned to the surface for air.

Now, when winter is drawing near, the spiders seek other shelter. A snail shell is usually taken, filled with air and closed with a tightly woven web. Within this chamber the animal awaits the reawakening of spring. Then, when the air is again warm and the ice has disappeared, the cycle of its life is repeated.



Showing the eight eyes of the water spider.

The mandible of the spider is shown above.

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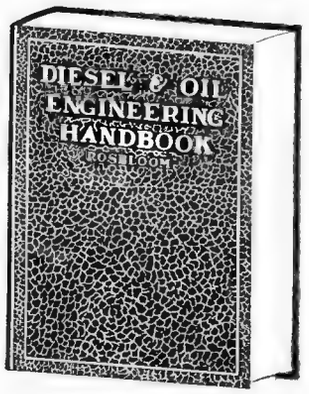

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World's Largest Electro-Magnet

By Count A. N. Mirzaoff

(*Continued from page* 1148)

(3-2/5 miles). To insulate it, there was required a cloth ribbon 28 kilometers long (17-2/5 miles) and 46 kilometers of mica (28-3/5 miles). Several electric motors are used in maneuvering various mobile parts of the instrument. Two of these parts weigh 25 tons each, yet they can be regulated to the very fraction of 1/100 of 1 millimeter (1 mm. = .039 inch). The instrument is installed in a specially constructed laboratory, where it is served by a battery of centrifugal pumps. A subterranean chamber is located underneath it. This has a constant temperature to facilitate the study of the optical phenomena produced by the magnetic fields. An apparatus to produce liquid air will soon be added to the installation.

What does all this mean to the ordinary layman? It means this. The mechanism may facilitate the penetration into the unknown mysteries of science; *i.e.*, the study of matter in general—its magnetic properties at high and low temperatures and the modification of the electrical and thermal conductability of such matter.

The magnet may facilitate researches on the structure of crystals and improve upon the theories of molecules and atoms. Molecules of matter are not spherical and their orientation by the magnetic fields will permit of determining their shapes. The atoms which constitute the molecules are thought to be in motion in a manner similar to the solar system. This miniature celestial mechanism may be so disturbed by the magnetic field that its structure can be analyzed similar to the way solar disturbances are caused by astral magnetic fields and the two are compared.

A luminous source of light submitted to the magnetic field acquires new properties. It is probable that by observing it in a magnetic field the nature of these will be discovered.

In the field of electricity, the electrons and protons are the cause of electric phenomenas. These elements, though small in comparison with the atom, move at very high speeds. It is thought that these charges can be followed in their course between the poles of this giant electro-magnet.

As an aid to the study of radio-activity, many new phenomena may be disclosed by subjecting radium and other radio-active bodies to the magnetic fields.

This instrument might also be utilized to advantage in research work in biology. Perhaps such powerful magnetic fields will affect organic matter. There are many other important investigations to be made in industries and manufacture. This instrument will render an invaluable service in solving some of the perplexing problems in science and industry; for example, certain metals now thought non-magnetic may prove to be magnetic in nature.

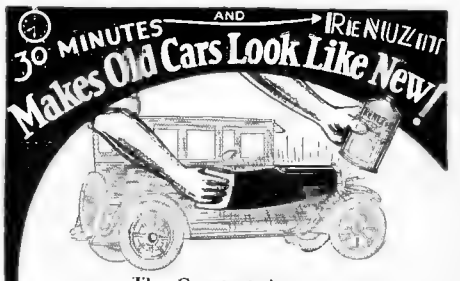
Oddities of Science

By B. P. Ziegner

(*Continued from page* 1149)

and a half. We see how little value water gives to us children of men. All of us, constituting so imposing a mass of humanity in appearance, wouldn't produce a wave such as every ordinary breeze produces by the hundreds in a minute.

If anyone has been interested in these little excursions into the realm of figures, let him think further; he will find many similar and always pleasant objects of entertainment.



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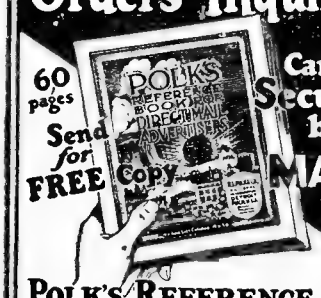

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.....Like a razor also, the pendulum was massy and heavy, it was appended to a weighty rod of brass, and the whole *hissed* as it swung through the air. I saw that the crescent was designed to cross the region of the heart. Down—steadily down it crept. The rats were wild, bold, ravenous, their red eyes glaring upon me. And then.....

From "The Pit and the Pendulum."

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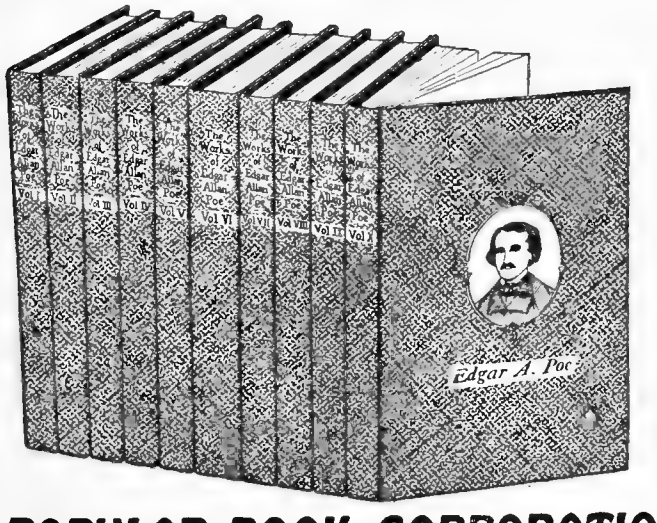

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Berlin to New York in Twenty-Six Minutes

(*Continued from page* 1135)

rays as it hung in the black heavens like a white hot ball. Right near the sun I saw the sparkling of innumerable stars, and not far from the sun was the sickle or crescent of the waxing moon. That is what would be said upon the earth, for in the dust-free stratosphere, we could see the rest of the moon quite clearly by light reflected from the earth! The officers of the flying machine prepared us for a really beautiful surprise. A large telescope was fastened air-tight in a universal joint passing through the walls of the machine and the always difficult observation of the moon through this instrument gave the observer a great and powerful impression. With plastic clearness, the observer saw the craters Godin and Agrippa in the sharp rays of their morning light and on the descending crater wall various kinds of rock could be distinguished. The freedom from atmospheric earth-dust and the optical nearness of our neighbor, the cosmic inter-relation of it all, forced one to think with deep humiliation of the over-conceit of earth-conquering mankind, who believed that its soul is the crown and summit of creation. Man here, in the face of the greatest wonder, appears like a lonely little spot on a great mountain.

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The bright sun blinded me, its strong rays overcame the glow of our electric lamp, and threw our room into relief with sharp shadows like a living wood cut.

At this time we found ourselves at about 50 kilometers above the surface of the earth, our clock showed 13 hours and 12 minutes. The outer temperature was 54 degrees below zero, and the atmospheric pressure was only one millimeter of mercury. Although the electric heating was turned off, we found it very warm in the interior of the cabin, thanks to the fact that the upper side of our airship turned towards the sun was dead black in color, and so captured the hot rays of the sun, which at this height are more powerful, and transferred their warmth to the interior of the vessel. There was little to see of the surface of the earth, the earth-dust glowed like a mist on a mountain lighted by the sun.

And now the time had come "to enter into the dining car," or would be except that this feature is impossible, unfortunately, in a stratosphere flying ship. We must realize that in eating food and drinking liquids on the surface of the earth, gravity plays an important role, as it draws the food down through the aesophagus. Although the peristaltic movement of the food tubes automatically urges the food forward, there is always the danger, especially in drinking, that something will take the wrong passage, and go into the lungs, and there occasion inflammation due to the presence of a

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strange body. After such an occurrence had cost the life of a machinist in a trial flight, eating and drinking in a space-flight is absolutely forbidden. There is also another reason for this prohibition Solid, drops of water and dust, during the absence of gravity, do not "fall" down, but remain suspended in the air, and the thoughtless behavior of a single passenger would disturb the inhalations of his neighbor, so one would be forced to put on a mask, and as quickly as possible, pass the air through a filter to keep a part of the dust out of it. The avoidance of dust is therefore the first duty of the stratosphere traveler. For that reason overshoes are worn in the machine.

Weightless Condition

An ordinary airplane is supported by its airboils with the "air cushion" below, and the partial vacuum above the surfaces.

The airplane on its part, carries its load so distributed that it is lifted as if in a basket, rear end first, from the flying field. The stratosphere flier, on the other hand, is like a projectile, after it has attained its highest velocity; it flies like a great stone thrown from one place to another by a giant. The gravitation of the earth is equalized by the centrifugal force due to its motion, so that the air-foils or wings are only used for starting and landing, as well as for lower speeds than the regular one. As the passengers are carried along with the speed of a projectile, they go along like stones, independent of the plane, perhaps not touching it, in their passage through the stratosphere. It is clear that it needs an enormous speed to reach such distant paths of flight, and our velocity must be therefore four kilometers a second; that is to say, we were driven through space with four times the speed of a cannon ball. During each second of our course, our velocity was accelerated by 35 meters per second by the rockets, so that for attaining the velocity of the earth, only three minutes were required, and this was accordingly the duration of the uncomfortable condition of super-gravity, as our captain expressed it.

As in the enormously long course of a projectile which would represent the stratosphere flight from Germany to America, the curvature of the earth would play a part, the astronomic laws apply here also. The rocket plane describes on its course the curve of an ellipse, one of whose foci is at the center of the earth. Having given its length of flight and the ceiling of its course, its speed and time can be calculated by astronomical laws. The period of flight from Berlin to New York, including the reduced speed at the start and landing, takes about 26 minutes.

I asked if the Kohlhoerster big radiation could not affect the passengers injuriously, but Kohlhoerster himself had declared that this momentary "radiation" was present in so slight an extent, even in the stratosphere, that any injury to the human organism was improbable. The stratosphere flier does not altogether miss the momentary radiations of the universe, as they, like the Roentgen rays, develop the photographic plate in the case. As lead glass has the power of cutting off at least a part of the short-wave rays, our windows are made of the same glass.

Nervous passengers talk about a collision with a meteorite. Although the star-fragments are seldom larger than a bean, nevertheless at the high speed of these metallic or stone fragments (40 kilometers a second) a collision would not be at all desirable. But these fragments of stone volatilize at about 120 kilometers over the earth's surface, because in spite of the extremely thin atmosphere, their velocity is so high that they are heated to gasefaction. A stratosphere plane has no probability of coming into collision with a meteorite. It has been calculated on a flight into the realm of the planets, that a rocket would have to fly for

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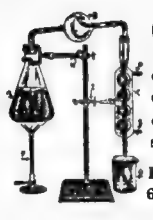

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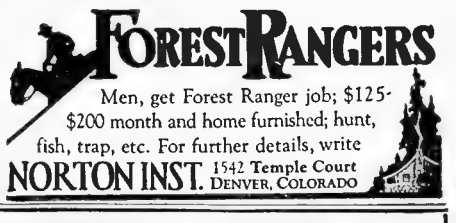
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one hundred years before there would be any probability of a collision with the fragment of a world.

At thirteen hours 24 minutes, the loud speaker gave the order to snap on the safety net and hold on by the hand straps. Now what is going wrong! The commander went once more through all the cabins to convince himself of our obedience to order, then there came a stroke of the clock and the braking of the plane by the reversed rockets began. This time I succeeded well in standing a few minutes of the discomfort of overweight. I tried by holding my head in the proper position, to withstand the disturbance of pressure in the middle ear, and to make as much use of my limbs as the net permitted. An accident which I saw threatening me, shortened up the two minutes of braking to a few seconds. The representative of the German sport papers, himself a passionate sportsman, seemed to have under-estimated the dangers of the abnormal pressure; he had secretly freed himself from the net in order to experience the feeling of supergravity. As he must have told to an acquaintance previously, he has been subjected to a very high pressure effect in tail-spins and airplane accidents.

As our braking was at the rate of 35 meters per second, including the reduction of speed as the surface of the earth was reached, brake pressure gave four times the force of gravity, an expression which naturally only applies to the direction of the flight. This braking process had just started when I saw the above-named gentleman in the corridor near my cabin holding on to one of the hand straps. He attempted to keep his feet on the floor, but at the very next instant he was jerked away, so that his legs pointed in the direction of the flight. I wanted to call out to him, to place his body perpendicular to the direction of the flight, but my call came unfortunately too late, the increased weight in the direction of the flight had made the blood flow into his lower body and legs, his face every second got paler and paler ,he let go and flew like an arrow against the wall only a meter distant, where he remained without motion. Meanwhile the braking rockets were cut off, our flight began to lose its residual velocity, the light penetrating the window became dull and obscure, and after a short time we came to the ground in Lakehurst. It was quite frosty, for it was then half-past seven in the morning, according to American time. The Americans were somewhat troubled about us because our flight, as we came down to earth, passed through a storm layer and it had already happened that rocket planes which came between two highly charged clouds were subject to an electric or lightning discharge, which burned up the plane and its inmates.

Our patient was immediately taken out of the plane to the N. Y. Central Clinic at 167th St. As was suspected, the patient had a severe concussion of the brain, several bones were broken and he had an internal hemorrhage. The blood, at virtually four times the normal pressure, was forced into the bones and expanded the blood vessels, and by the backs of the feet one could see that the blood, on account of the increased pressure in the extremities, had left the capillaries and had gone under the surrounding membrane, but without any injury to the different parts. When we left the sick room the signal in the hall showed to the surgeon that he was needed at once in a room of the inner division. The telephonic information was to the effect that a German representative of the press was sick there. It was really a man out of our set, who before the descent had drunk several glasses of beer, and showed a sweating out of serum and a transudation in the chest. He had lain, during the braking, with his back against the pillow, and acknowledged that he had found out how, through the great pressure,

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he had got water on his chest. For both of these cases there was a conference in the medical office of the clinic over the physiological and pathological effects of supergravity and absence of gravity, in the course of which I remarked with astonishment what extended investigations over this problem were already in process in America.

Going out of the clinic I betook myself at once to my hotel to write down this account as soon as possible, and here is another sensational surprise. The report of the German representative of the press at 12 o'clock mid-day, was sent with an Oberth-Goddard postal rocket to Germany, where it was expected at 18:30 o'clock middle European time.—*Courtesy Die Umschau.*

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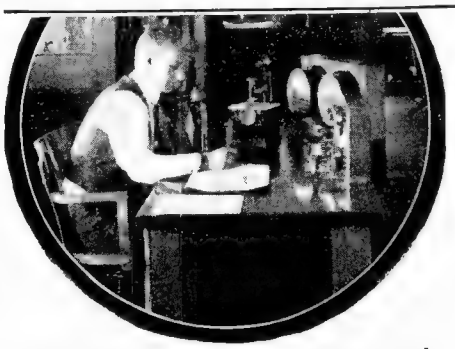

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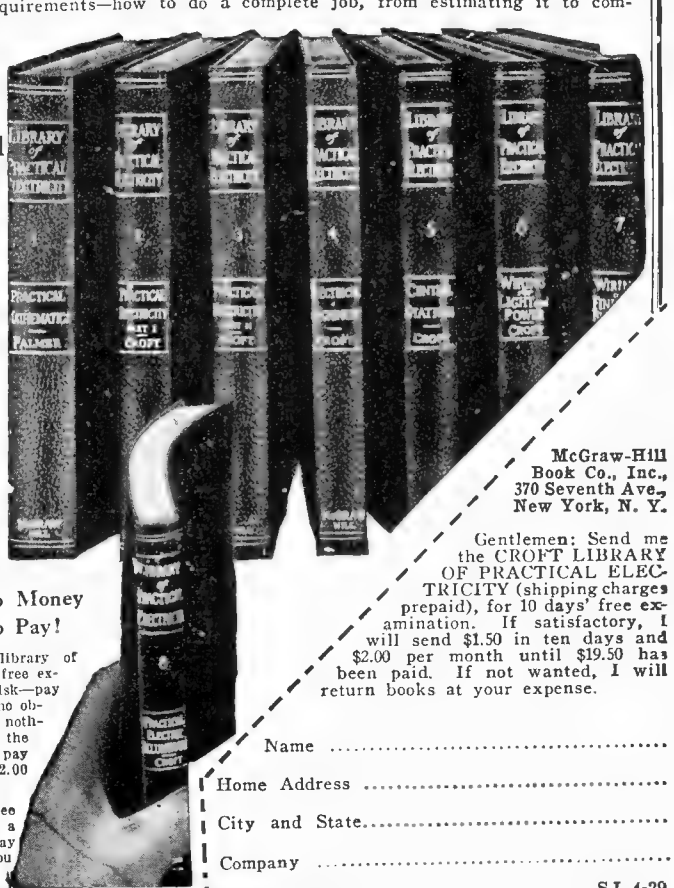

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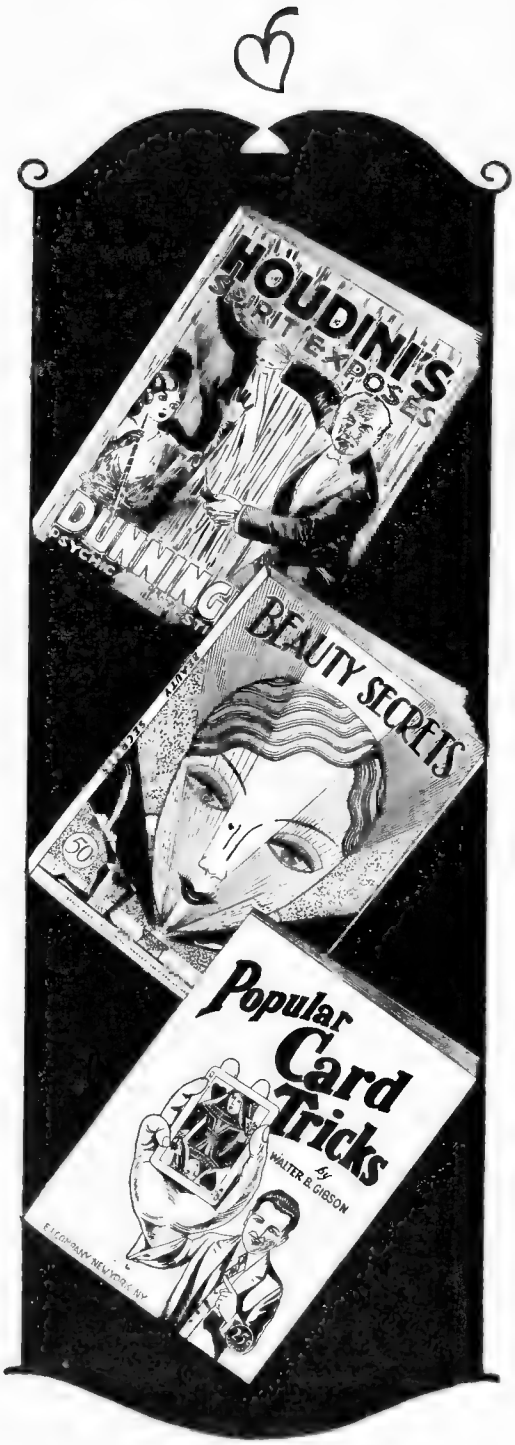

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Trail Blazing to Millions

By Roger W. Babson

(*Continued from page* 1140)

tremendous sources of latent power now going to waste. Millions of tons of shipping are lifted twice each day on every ocean. The tides can furnish us with enormous power if harnessed. Look for developments in that direction in the next twenty-five years.

Similarly, the heat of the earth, the power of the sun may be used some day.

Medicos and Chemists

THE sales possibilities of the ordinary electrical appliances already in the market are enormous. But even greater opportunities lie in the application of new electrical discoveries.

Can we harness practically the ultra-violet short waves? Their possibilities for health are potent. Workers in the immediate range of ultra-violet waves complain of increase of bodily temperature. A worker's temperature increases to 100 or 102 degrees, the man goes home ill, and after he gets there, his temperature is gone and he is baffled.

It is very possible that some one will discover a use for this phenomenon. Why heat rooms in winter? All we want is our own personal, bodily comfort. We don't want to heat all the air in the room if our bodies are warm.

Perhaps the electrical short wave will thus be used some day. And possibly we shall live to see the day when *all* artificial heating of rooms will be eliminated.

A short time ago there was held a luncheon at which every food was made synthetically. The cream, butter and milk had come from a kerosene plant. The soup had come from the by-products of a Canadian brewery. Not a single dish of food, not a bite of edible at this luncheon, had ever seen the farm or dairy.

Thomas A. Edison told me that if he were a young man starting to study he would learn chemical engineering. And Mr. Edison added, "We know yet very little about anything."

Somebody is going to make millions of dollars cooling buildings in summer time. Twenty-five years hence, if not sooner, every up-to-date hotel, theatre, office building and factory will be cooled artificially. This may necessitate the elimination of windows, but artificial cooling is coming and so are the millions with it.

Gasoline and Oil a Municipal Monopoly

THE average American home spends more money each month for gasoline than it does for water, electricity, gas, and sewer.

In April Radio News

HOW TO BUILD A HANDSOME RADIO CONSOLE—A Blueprint Article Beginning a New Department

THE SERVICE MAN—A New Department

THE "HOME-BUILDER'S SEVEN" SUPERHETERODYNE—A Blueprint Article

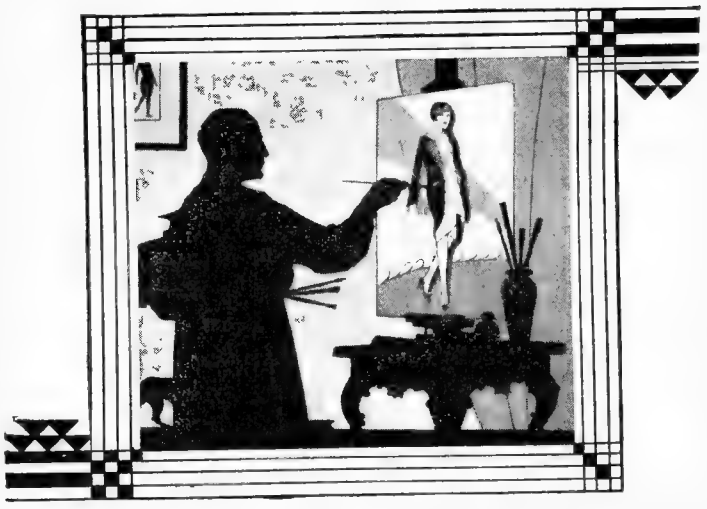
THE "SPACE-CHARGE AUTODYNE"—Short-Wave Set with Screen-Grid Detector—A Blueprint Article

USEFUL AND EXPERIMENTAL APPLICATIONS OF LIGHT- SENSITIVE CELLS

SHORT-WAVE AERIALS AND GROUNDS

FOR THE BEGINNER—Phonograph Pick-Up Devices and Adapters

METHODS OF DETECTION AND THEIR MERITS



ARTISTS EARN MORE

WHILE you are dreaming of making money . . . enjoying life . . . why not train your talent for drawing? A fortune may be at your finger tips if you train them now. Many people do not realize they have artistic ability. Through art, you may find the way to a famous name and a large income.

Artists are paid more today than ever before. Since the war, rates for art work have increased tremendously. Advertisers and publishers are paying millions of dollars annually to those who are trained in Modern Art.

Think of the money paid to artists for the illustrations in this magazine alone. Hundreds of successful students of the Federal School of Illustrating are now making from $2500 to $6000 a year and some are making even larger incomes.

More than fifty famous artists . . . earning big money themselves . . . have contributed their drawing secrets to the Federal Course. Clare Briggs, Neysa McMein, Sid Smith, Norman Rockwell and many others know the way to make money though art. The Federal Course teaches you their methods of Illustrating, Cartooning, Lettering, Poster Designing, Window Card Illustrating, etc. Through this course you can learn at home during your spare time.

TEST YOUR TALENT—FREE

Why be content with a small income at routine work when art training offers such possibilities? Write your name, age and address on the coupon and get the Free Book, "A Road to Bigger Things" illustrated below. It gives details about how famous artists of today started their careers and shows examples of our students drawings. With it, you will receive our Free Vocational Art Test. Clip and sign this coupon now. It may be the beginning of an art career which will enable you to clip bond coupons and sign big checks later.

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The world we live in

TODAY the world is literally at our doors. A spin of a dial, and we listen to the President in Washington, or a football game in San Francisco. From our talking machines the greatest of operatic stars sing to us, the foremost dance orchestras play lively syncopation of our choosing. Our automobiles stand ready to whisk us over smooth boulevards to new scenes. Monday is no longer blue: the family washing is done by electricity; so, too, is the cooking, and the preserving of food, and the sweeping of floors.

Yes, the world we live in has changed . . . changed marvelously for the better.

Have you ever stopped to consider the part advertising has played in this change? Glance over the advertisements in this magazine. How many of the products mentioned are old friends of yours, familiar because you already own them or intend to get them soon! And the articles in your own home. Every one of them, probably, is advertised, either here or elsewhere. *The chances are you first learned of them through the advertisements.*

Advertising is important to you because it keeps you informed of the changes in the world. It tells you of new products, of improved designs and workmanship and materials. It helps you to spend your money wisely and well. It points you to the better things of life.

Advertising is the herald of progress.

This BOOK 10¢

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Otto Wiegand, Md., home-study graduate, made $12,000 from his business in one year. John Vassos, N. Y., gets $25 for a show card. Crawford, B. C., writes: "Earned $200 while taking course." Write for complete information.
DETROIT SCHOOL OF LETTERING
179 Stimson Ave. Est. 1899 DETROIT, MICH.

Do you suppose we are going to have filling stations on every corner forever? Don't you see that the tank car delivery method may be swept away and that all oil and gasoline may be delivered through pipe lines to the consolidated filling stations?

We are going to live to see this. The stations and service companies will be consolidated. The price of gasoline will be regulated by a Goverment Commission—as electricity and other necessities are now.

Production Efficiency to Come

I SUPPOSE most of us believe we are in an era of mass production. Of course matches are made by modern methods. It would cost $4 or $5 for a box if hand-made.

But how about shoes? How about clothing? How about numberless other necessities

A prominent shoe manufacturer told me that only the counter of his shoes were made by mass production. *One twenty-seventh (3.7%) of a shoe made by modern machinery!* The rest of the shoe (96.3%) almost the entire shoe—made by old, slow, pokey, inefficient means.

Isn't there a wonderful incentive for the mechanically-minded experimenter?

True mass production—not the kind we have today—will make millionaires by the dozen.

Silk Worms are Discouraged

IN the last few years the silk business has received an awful jolt from the artificial silk makers. And well might this be, for rayon is going to make dresses almost as cheaply as newspapers.

Note that the cost of manufacture will be low. Only style will prevent a great reduction in the price of women's clothing.

Rayon is made from pulp. Thread is then made from the pulp. Then the material is woven, cut, and handled like ordinary cloth. The only reason they make thread, and weave it, is tradition.

When the pulp is churned up, it immediately should be made into cloth—as paper is made—and come out as finished underwear. Some time in the future it will come out finished, folded, wrapped in tissue paper, boxed, and ready for shipment.

A manufacturer who is known in his trade as one of the foremost makers of printing machinery, tells me that this process will occur almost before we expect it. New methods of mass production in the textile industry, which will eliminate weaving, offer great opportunities for money making.

Watches Run by Radio

TODAY we have clocks which are regulated and kept operating by a master clock in a distant power house. If we already keep our clocks correct and operated by electricity, why can't we do likewise with our watches?

I expect the day to come when every municipality will supply free radio power to keep every watch running and in correct time.

Transportation of Coal

COAL shipping will be a thing of the past ages. We ship coal hundreds of miles. We drag it over our city streets. We stoke ten million furnaces, then sift ashes. Again we haul tons of ashes around the streets out to the city dump—and what for? To keep warm!

Twenty-five to forty years hence it will be as illegal to have your own coal fire at home as it now is to have a cesspool. Unless we use the short waves as already explained, we are sure to have central heating systems such as colleges and factories have now, or else use gas.

Buildings at Harvard University are warmed by exhaust steam from an electric

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power plant half a mile away. We won't stand still in this matter of heating. If we do get large-scale steam, gas, or electrical central heating, it will mean a great impulse in the insulation business. New insulators will be needed, new methods of creating millions of tons of insulator, handling it, and applying it will arise.

Why Not a Quiet Street Car

WHEN, oh when, will somebody present us with a quiet street car? The railway men take power from a trolley with one little metallic wheel. Then they send it back *via* the rails with EIGHT wheels.

The solution is simple. One metallic wheel under the car is sufficient to return current. The other seven wheels can be rubber-tired. In that way much of the noise would be eliminated at once.

Of course we will do away with surface cars in cities of less than 100,000. The cheap "subway" will be the solution. Today when you stop to watch a sewer or telephone or other under-street-surface gang working on a huge municipal tunnel do you see anything? Can you not see that already some of those water pipes below the earth are one-quarter the size of a subway tunnel?

Subway construction will be by pre-cast pipes. That is how every city of more than 100,000 population will have a subway. The larger cities will need a few surface cars to connect with the tunnels. But even they will be few.

Meanwhile There Will Be Automobiles

THE 1928 automobile industry seems a settled and stabilized affair. Cars attractive in appearance we drive and as we look at the buggies of twenty-five years ago with whip sockets, we snicker.

If we are so superior, why can't we get more than the present low efficiency from gasoline motor cars?

Rotary engines instead of reciprocating engines will come into use. The exhaust will come out of the roof. Cars will move sideways when parking. A different fuel will come into use.

Parking the Automobiles

PARKING in congested areas—does someone ask? That has been solved already. I refer to the automobile garage. A car drives into the entrance way. The owner gets out, goes to a wall-panel, and selects a key. Underneath the key hook there is a button. He presses the button and goes out to his office.

Meanwhile the car is taken automatically (by the pressing of the button, machinery is set working) up to a floor where it is parked and locked so it cannot be moved. At the end of the day the owner returns, inserts the key in the proper lock on the panel, presses the button. One minute and thirty seconds later the car is at the front door waiting for him. No hands have touched or guided it. In a few years every city will have the automatic garage.

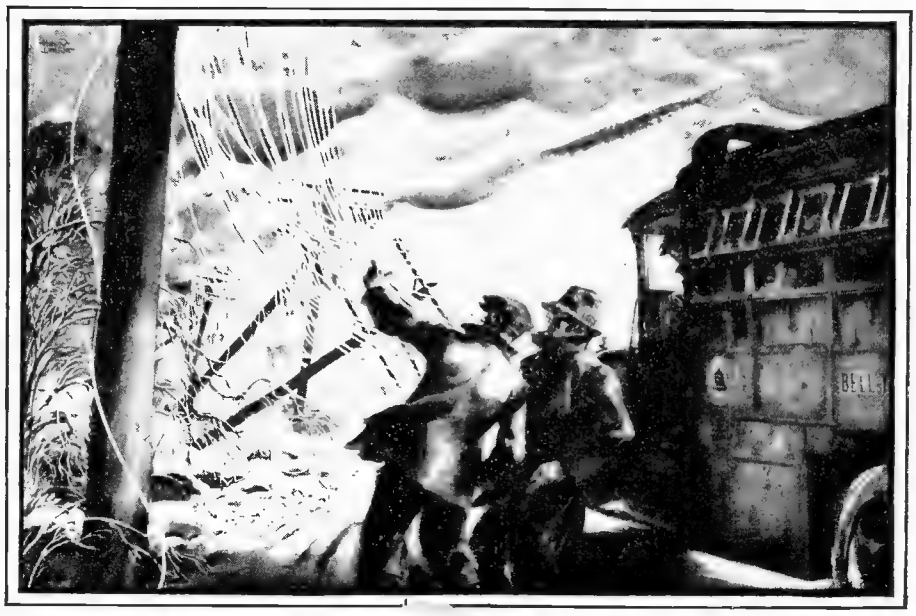
The Horizontal "Elevator"

ANOTHER simple device badly needed is the horizontal "elevator."

A horizontal conveyance is needed for use in department stores, hotels, hospitals, and other large buildings. *The present methods are only temporary.*

See what we today find in our department stores. We ride up two flights. When we ask where a certain article is, we are directed to a point an eighth of a mile down the aisle to the left. A horizontal conveyance will be one way of getting a million dollars.

(*Continued on page* 1200)



Suddenly, out of a spring sky . . .

An Advertisement of the
American Telephone and Telegraph Company

ALL was well on the telephone front on April 27, 1928. Suddenly, out of a spring sky, rain began to fall over central Pennsylvania. As night came on this turned into a furious storm of sleet, snow and wind. Inside of 48 hours, 3700 telephone poles were down. Seven thousand miles of wire tangled wreckage. Thirty-nine exchanges isolated. Eleven thousand telephones silent.

Repair crews were instantly mobilized and sent to the scene. From Philadelphia 47 crews came. Other parts of Pennsylvania sent 13. New Jersey, 6. New York, 4. Ohio, 6. Maryland and West Virginia, 12. In record time, 1000 men were stringing insulated wire and temporary cables along the highways, on fences and on the ground.

Within 72 hours the isolated exchanges were connected and the 11,000 telephones back in service. Then, while the temporary construction carried on, neighboring Bell System warehouses poured out all needed equipment, new poles were set, new crossarms placed and new wire and cable run.

In any crisis there are no state lines in the Bell System. In all emergencies of flood or storm as well as in the daily tasks of extending and maintaining the nation-wide network, is seen the wisdom of One Policy, One System, Universal Service.

Better and better telephone service at the lowest cost is the goal of the Bell System. Present improvements constantly going into effect are but the foundation for the greater service of the future.

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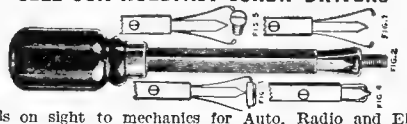

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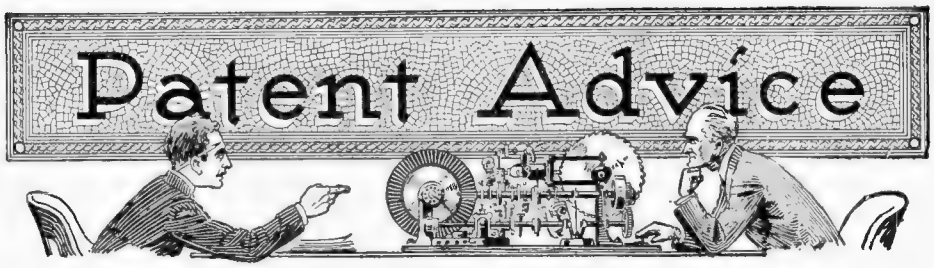


CONDUCTED BY JOSEPH H. KRAUS

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain patent phases. Regular inquiries addressed to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are published here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail, a nominal charge of $1.00 is made for each question. Sketches, and descriptions must be clear and explicit. Only one side of sheet should be written on.

NOTE:—Before mailing your letter to this department, see to it that your name and address are upon the letter and envelope as well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given.

Fountain Tooth Brush

(1161) Albert McClellan, Bowie, Texas, asks whether it would be advisable to get a patent on a fountain tooth brush and also on a laboratory dissecting set including the usual group of dissection instruments, together with a magnifying glass.

A. 1. The idea of a fountain tooth brush is not at all new and you will find that there are many such tooth brushes already patented. Such tooth brushes are very unsanitary because it is impossible to clean away the paste which forms around the opening leading to the bristles. Also, it is quite impossible to seal this opening and prevent caking of the paste. We advise no action on this idea.

It is impossible to get a patent on a laboratory dissecting set combining a group of instruments. If your design for such a set were different than those already on the market, you get a design patent, but a mere grouping together of well-known instruments in a suitable case does not constitute a patentable device.

Hair Trainer

(1162) Robert Karr, St. Louis, Mo., has designed an elastic cap for keeping the hair in place. He asks our opinion.

A. 1. If you will refer to SCIENCE AND INVENTION Magazine about two years ago you will see that such a cap was already then in existence, and was also used as a trainer. While not made exactly as your cap, it was intended for the production of waves. Your suggestion might take if properly exploited by some large international beauty specialists, and sold by them. Actually the device is no better than a sock tied together at the top, a swimming cap or any of a dozen different systems which could be substituted for it, and which would be manufactured if your device ever became popular.

Combination Writing Paper Envelope

(1163) John Mamtell, Detroit, Mich., asks whether he could get a patent on a combination writing sheet and envelope. The sheet of paper on which the writing takes place forms the envelope by means of two flaps which are gummed. The overlap is perforated so that it can easily be torn off to disclose the contents. He asks our opinion.

A. 1. Your suggestion is not at all new. It has been tried in this country and discarded time and again. The public for some undivulged or unsuspected reason do not care to use paper of this nature, yet in France such paper was until recently very popular and many letters coming from the other side were written on such combination letterheads and envelopes. We do not believe that any action on your part would guarantee an income, and we consequently would not advise you to continue further with this suggestion.

Motor Driven Wood Plane

(1164) Joe Lesko, Mohawk, N. Y., asks whether he should patent an idea of a combination motor and plane. No details are given to warrant a definite answer.

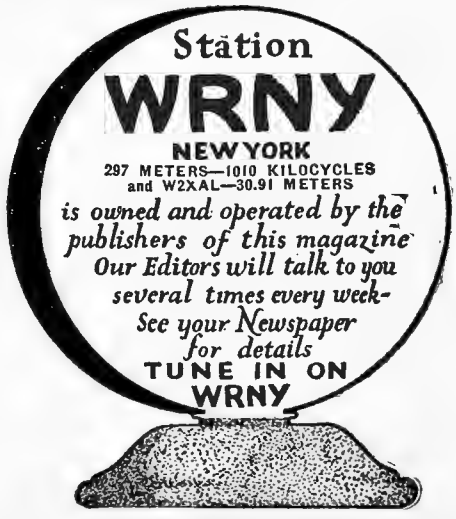
A. 1. The idea of using a power wood plane, in which power is used to drive the plane, is not at all new, and unless you have some novel feature, we doubt if it is patentable. The same story holds for the bicycle three-speed transmission. Many bicycles are equipped with such three-speed transmissions. This three-speed transmission is also available on the market, so that it can be easily attached to any bicycle.

Milk Bottle Stopper

(1165) Felix Benassi, Charleroi, Pa., has designed a new milk bottle stopper, the nature of which is made clear in the answer. He asks our opinion and also asks information concerning a possible new use for an existing patent, and wonders whether he can patent it from the standpoint of this use.

A. 1. The milk bottle stopper which you have designed is not at all new. On several occasions, organizations in this country have attempted to use a stopper with a lip on similar to yours, and also other stoppers in which the lip was impressed into the top. In either case, the product was only used for a short space of time, and then discarded. We are confident that you could not secure a patent that would be broad and basic on this suggestion.

Using one product for another purpose is not a patentable claim. Toilet paper as well as paper towels come in rolls. Newspaper comes in rolls. There is no reason why any manufacturer could not place writing paper in rolls, and this is even done by the organizations manufacturing and selling automatic typewriters. Instead of having perforations, a knife cuts the paper clearly and sharply.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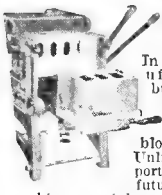

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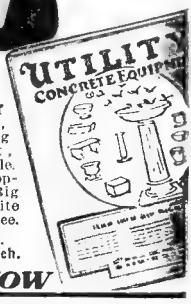

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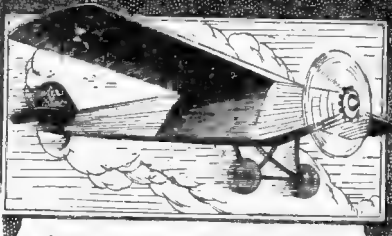

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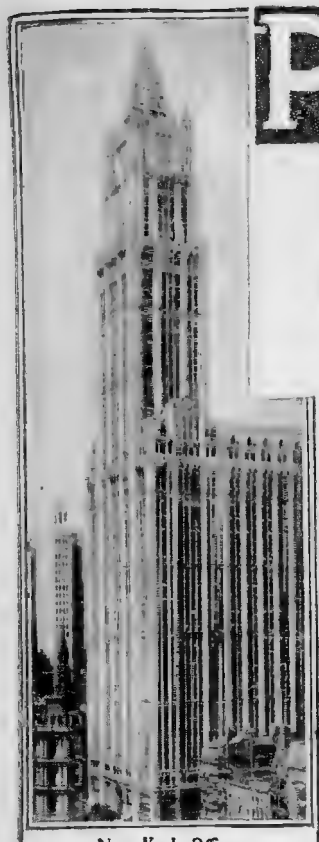

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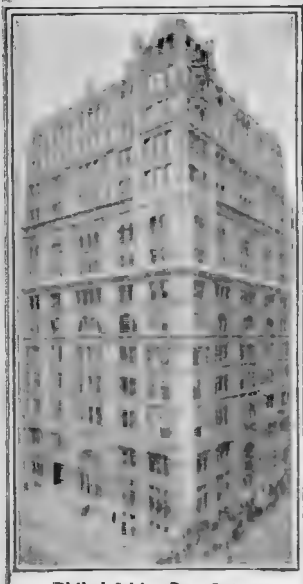

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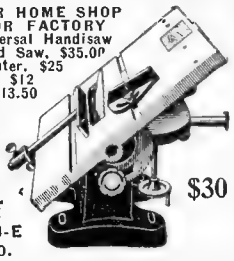

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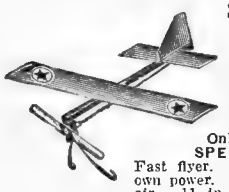

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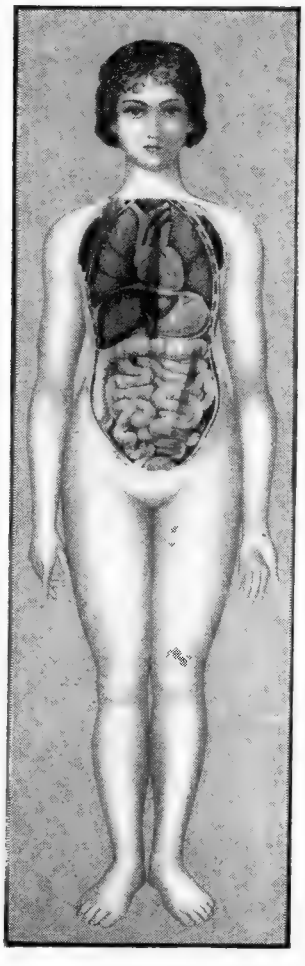

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Space-Time and Relativity

(*Continued from page* 1196)

stuck to your definition. Measuring is not easy, though. As we have already seen, we first require a rigid ruler.

P: We have standards of length that are almost perfectly rigid.

R: Then the best we can do is to decide that a given line is almost perfectly straight, i.e., within the limit of error of measurement. I'm afraid that is not very satisfactory to the mathematician, though, for any number of lines that fulfill this condition can be drawn between two points.

L: But certainly one is shortest of all.

R: There you go, again introducing a conception of length that does not involve our standard, to which, we have already agreed, we must stick.

L: But surely there must be such a thing as a straight line quite apart from measurement. I drop this rock. Its path through space is a straight line.

R: If you want to define a straight line in that manner I shall not object. You see the rock fall in a straight line. To an observer on the moon, however, it would appear to move in quite a complicated curve. Still another curve if viewed from the sun. That would make straight lines relative rather than absolute—to which I agree.

L: Still I do not give up. Would not a ray of light travel in a straight line?

P: Einstein predicts and astronomers have proved that a beam of light passing near the sun is deflected.

L: We could allow for that.

R: By what standard? If you chose a ray of light as your pattern of the perfect straight line—

L: I begin to understand. The difficulty is very similar to the problem of measurement. Once I choose a standard I must gauge everything to it, and in case anything goes wrong I cannot blame the standard.

R: You are quite at liberty, if you wish, to place the blame on the standard. But do not tell me that the standard is wrong, because you then imply that something can be more correct than your standard—which is impossible. To turn to the next point, what are parallel lines?

L: Lines that keep the same distance apart.

R: That introduces measurement again and it is quite possible that many lines can be drawn through a given point, parallel to a given line, contrary to Euclid's postulate.

P: We often hear the expression that space is curved or warped. Just what does that mean?

R: That is a popular way of picturing space that does not follow the above geometrical principles prescribed by Euclid. Here are a series of circles—The first with a radius of one centimeter, the second two, the third four, and so on—doubled each time. I can only show a couple of them here for they increase in size so rapidly. The question that enters the mind is, can we keep on increasing the size of such circles indefinitely? According to Euclid, with infinite space, the answer is yes. Einstein, however, says no; the ninety-sixth circle would be the last one that can be drawn in our universe. Finally, we come to a point where no possible measurement can distinguish between the arc of one of these huge circles and our ideal straight line. If we could get into Jules Verne's projectile and travel with the speed of light (186,000 miles a second) in the "straightest line" we could possibly negotiate, we should be moving along this ninety-sixth circle and, after five hundred billion (500,000,000,000) years, we should return to our starting point. The universe is, therefore, finite.

EDITOR'S NOTE: Next month Dr. Menzel will discuss in the third article of this series, "What Is Time?"

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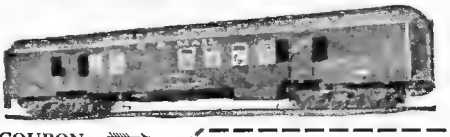

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(*Continued from page* 1191)

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Rust of Steel

RUST is passing from this world. The next generation may be able to see rust only in museums as example of decay before the days of stainless steel. Think of what it will mean when there is no rust. There will be no weakening then of important members in bridges, wharf, or water main, etc.

Decay of Wood

Why not prevent wood from decaying? The wood of a generation may not decay either.

Yes, woodsmen might even try innoculating hard woods into valuable woods. Oak, birch, maple, and other hard woods may be transformed into mahogany.

Dozens of Other Possibilities

IN every one of the following ideas there is a million dollars. Some of them are working now but need extension and development. Others are not as yet practical. But the airplane will be as numerous as the automobile, when we have the helicopter. Airplanes will fly in trains. Incidentally, while the dirigible is of value for what it teaches us experimentally, I have not much enthusiasm for it.

We need cold light. We need a lamp that will pierce through fog. In order to save the forests we must make paper from grasses and by-products. We are now making corn stalk paper—from a waste product. A certainty is *vision over the telephone—television!*

Flexibility in glass is just as desirable as bullet-proofness and unbreakability. Gliders need be no larger than bicycles. Metals may be transparent. The weighing machines of ten years hence ought to count. Automatic chain stores may use vending machines exclusively. Fountain pens may write in two or three colors. One prominent fountain pen manufacturer will pay a fortune for this invention today.

Gunpowder will be used to fight fires and we shall have tooth powders which prevent decay, really. Automobiles may use Diesel engines and low-grade fuel.

Can We Speed Up Mentality?

THIS seems quite an imposing list. Yet it is the least of what is coming and what is needed. All—or practically all of the inventions of the last fifty years have been to reduce or eliminate physical labor. Manual labor is reduced when we have transportation systems. Physical energy is conserved when we have digging machines to dig out our foundations. But what have we done to conserve mental energy?

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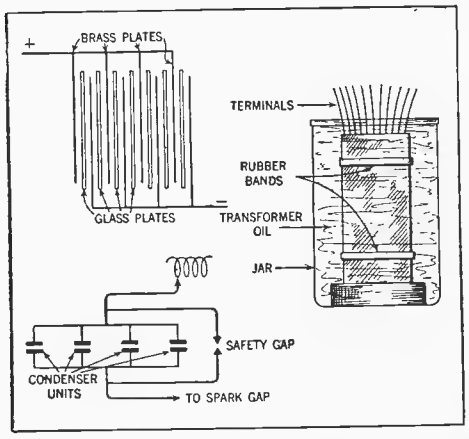
How to Build a Giant Tesla Coil

By E. L. Richards

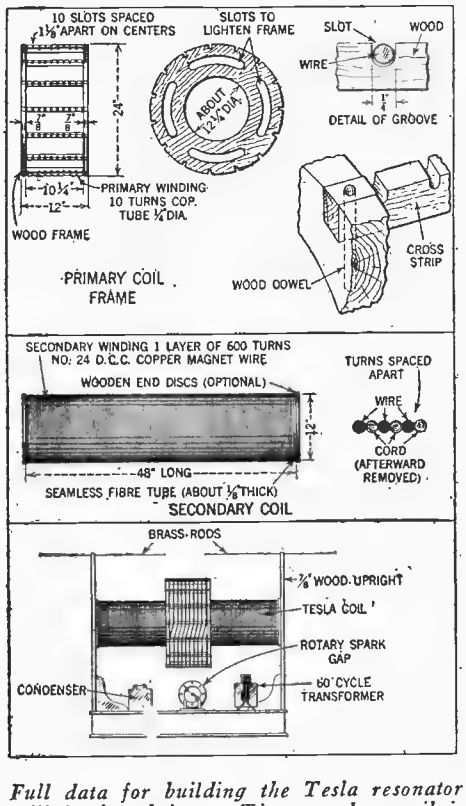
(*Continued from page* 1159)

from an aluminum pitcher with the other, and into a pan on a second stool (not grounded). Another person can then light a cigarette from the stream of water. The cigarette can be prepared by running a fine wire through it to make contact to the person's hand, and the cigarette end moistened with alcohol or naphtha.

Often two persons standing several feet from the operating coil and in no way connected to it, can draw short sparks by touching their fingers together. At night or in a darkened room, the corona effect about the coil and wires is beautiful. An electric pinwheel of the well-known type with spark streams from the points, can be revolved at surprising speed when pivoted on one of the coil terminals.



Details of the condenser unit are given above. The condensers can be built in three or four rubber or glass jars to obtain flexibility or adjustment by connecting them in parallel.



Full data for building the Tesla resonator will be found here. The secondary coil is 48 inches long and 12 inches in diameter.

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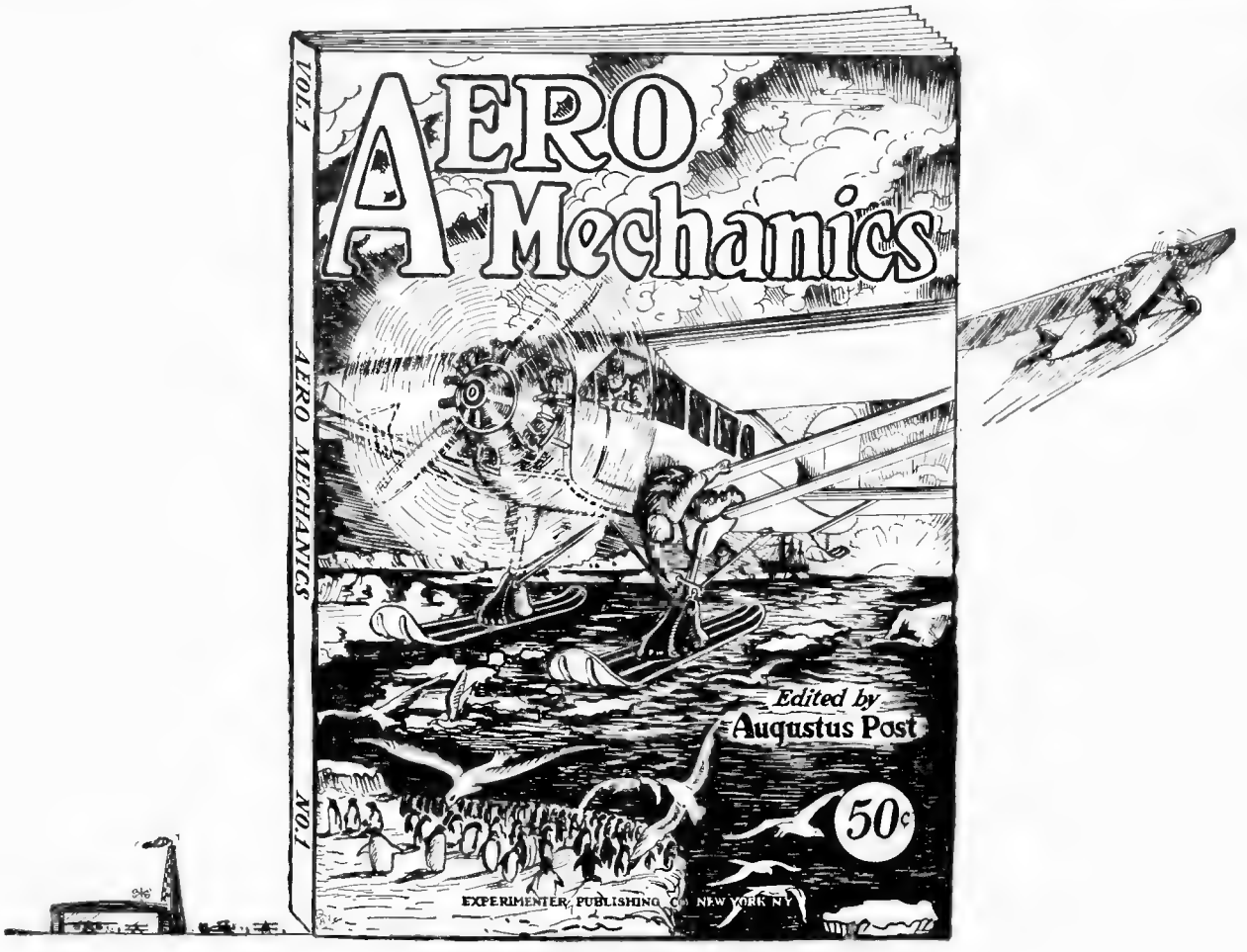

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"Rev." Ford Faked Houdini Message

By Rea Jaure

(*Continued from page* 1151)

séance at the Houdini home, Mrs. Houdini withdrew her reward of $10,000 offered for the correct message from her husband. She explained that sincere mediums had urged her to do so, declaring that such a bait not only tempted those in spiritualism for mercenary purposes, but interfered with the efforts of those who, in all sincerity, were trying to establish contact with the departed.

Mrs. Houdini appreciated the way in which a previous interview with her was published and phoned the writer her thanks and offering a "Big Story" after the first of the year.

Later she phoned an invitation to join a party she was giving. Following instructions, I took a taxi to Rockwell Palace on 8th Avenue near 159th Street. At this peculiar ball given by temperamental people, I was introduced to a number of her friends, including one "David Fletcher," who was Mrs. Houdini's escort. (*Note: Name of Ford's guide was also "David Fletcher."*)

The Code "Message" Received

SOON after Christmas I was notified of the illness of Mrs. Houdini and requested to make mention of it in the paper. This I did. I inquired daily as to her condition. The Sunday before the séance her companion, Mrs. Minnie Chester, told me I should come and see the invalid. I called Monday. From beneath the pillow on the couch where she lay, Mrs. Houdini produced a letter that she said had been brought to her the day previous by Francis R. Fast and John W. Stafford. It stated that Ford, the medium, had in their presence gone into a trance and had received from Harry Houdini in the spirit world, a message in a code of ten words, with instructions to take it to his wife, with whom he had agreed to communicate if able.

The ten words were *"Rosabelle, answer, tell, pray, answer, look, tell, answer, answer, tell."* The missive was signed Francis R. Fast, John W. Stafford, Helen E. Morris, Dorothy B. Stafford.

"I told the gentlemen that the ten words interested me,' said Mrs. Houdini, "but what did they mean? I must know more if I am to believe. I then agreed to receive the medium and allow him to hold a séance at my bedside." Mrs. Houdini invited me to be present. She went to the phone and called Circle 4959 and addressed someone as "David," making an appointment for noon the following day for the séance.

Mrs. Houdini permitted me to take the letter brought to her, to the *Graphic* office, to have a photographic copy made, under promise that I would return the original immediately, and hold the plates and copies until she released them. At 6 P. M. I returned to 67 Payson Avenue and returned the letter to Mrs. Houdini.

Advance Details of Séance Given

NEVER having witnessed a séance, I requested Mrs. Houdini to acquaint me with such details as she could as to the procedure so that I could prepare a part of my story in advance, as newspapers have what are known as edition *dead lines*, and I was anxious to get the story in time for publication the next afternoon. The following was her reply:

"I shall lie on the living room couch. When Mr. Ford enters, with those whose names you will ascertain at the time, I will be introduced to him and say, 'I don't suppose you remember me. I came with others once a long time ago to Carnegie Hall, where you were denouncing Houdini from the platform.' I had distributed in the audience 300 copies of Houdini's little book telling how it is possible for spiritualists to manage to bamboozle the public with trickery.

"'Yes,' Ford will say, 'I was told afterwards that you were Mrs. Houdini. This is not a good way for us to meet again. Come, let us sit and see if I can convince you that I am at least sincere,'" Mrs. Houdini continued.

"Ford will appear to go in a slumber, and directly say, 'Hello, Bess; the *guide* will be *David Fletcher.*' He will say, 'Houdini is here and wishes his wife as faithful in death as in life to receive his message.'

"He will then call 'Rosabelle,' and bid me remove my wedding ring. This I do and sing,

'Rosabelle, sweet Rosabelle
I love you more than I can tell,
Over me you've cast a spell;
My charming, blue-eyed,
Sweet Rosabelle.

"I will then say, 'Je tirai le rideau comme ça.' Ford will say in a trance, 'I draw the curtain,' and repeat the ten words (given in letter you photographed.) Then I ask for the code ten words and he says: '1—pray, 2—answer, 3—say, 4—now, 5—tell, 6—please, 7—speak, 8—quickly, 9—look, 10—be-quick.' The 26 letters of the alphabet are formed by number combinations of the same. *Answer*, the second letter, is *B. Tell*, the fifth letter of the alphabet is *E—pray answer* is a combination of 1 and 2, meaning *L,—Look* is 9th letter, *I—tell* is fifth—*E—Answer answer* is the 22nd—*V—, tell* 5—*E.* The word is *Believe!'*

"It is rather intricate," said Mrs. Houdini, as she took my pencil and paper with notes, over which I was struggling, and finished writing the numbers, words, and finally the word *BELIEVE.*

"There now," said Mrs. Houdini, "that is the whole thing as it will happen, except that I say, 'Yes. Yes, that is the message. Harry—Harry.'"

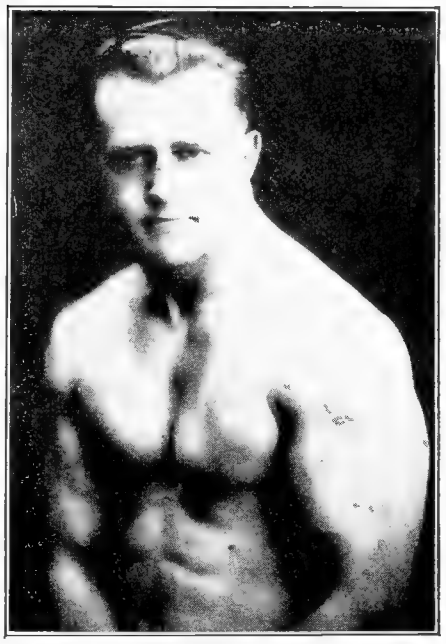
The séance was held Tuesday noon. Events occurred methodically as recorded, except that Mrs. Minnie Chester leaned over the widow and reminded her to say "Harry—Harry."

I telephoned the *Graphic,* telling them to get my story and release it quickly. I gave the names of those present—Mr. Fast, Mr. and Mrs. Stafford, Charles Williams, Mrs. Houdini's publicity agent, Harry Zander, representing a newspaper syndicate, and Mrs. Minnie Chester. It was printed in good faith.

A Misunderstanding

I DID not return to the office that night. The next morning I went to see Mrs. Houdini, and told her that Charles Williams had been down to the office relative to selling some stories written by him, under her signature, some time before. Mrs. Houdini became excited and said, "They must not be printed—I won't have it." I asked her if she would mind writing another first-person story. She replied that she did not want to have published any signed story, adding, "I have another very big story I will give you." I told her all right to give it to me. "No—no, not now," she screamed. I then told her I did not believe I wanted it at any time. This in the presence of a notary from the *Graphic* office, Miss Quigg, who I had taken with me. This made Mrs. Houdini very irritable, and in a loud voice, she profanely told me what she thought of me as a newspaper woman, for not having published the séance news sooner than I did. I reminded

(*Continued on page* 1209)



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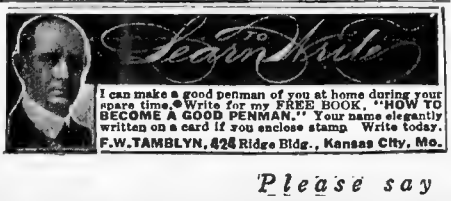

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Making the Movies "Talk"

(*Continued from page* 1139)

the motion picture images. In this case the voice or other sound is picked up by a microphone in the manner just outlined, with the difference that the voice currents, after suitable amplification by means of a vacuum tube amplifier, are made to cause fluctuations in the luminosity of a small specially designed lamp, placed on one side of the film. These light fluctuations, corresponding to the undulations of the voice, are impressed photographically on the film, when the film is developed, the voice pulsations appear in the form of varying bands of light and shadow in a narrow strip at one side of the film.

Having thus recorded the voice on the same film with the picture, the matter of synchronization, that is, of keeping the picture and voice in perfect step, has been simply and successfully accomplished.

The next important and interesting bit of science comes into play when the voice is to be reproduced from this record on the movie film. One of the accompanying diagrams shows how this is accomplished, by having recourse to a light-sensitive device known as a photo-electric cell. A small lamp containing a highly concentrated filament, passes a beam of light through the narrow voice record band at the side of the film, as it moves by the lens shown in the diagram. The voice bands, or light and dark shadows corresponding to the various sounds, permit more or less light to pass through the film onto the photo-electric cell. The photo-electric cell possesses the remarkable property of instantly translating these light pulsations into electric currents of identical wave form, and these photo-electric cell currents are passed through several stages of vacuum tube amplification, from which point they are led to the loud speakers placed at the rear of the movie screen. The accompanying pictures show the style of exponential horns used back of the screen, where theatres are equipped for projecting talking movies. In some cases, horns are placed at various points about the auditorium, but the standard method in most cases now seems to be the arrangement of four large horns, mounted on a movable frame, rolling on casters in the manner we have shown, which enables the stage to be quickly cleared for dance numbers, etc.

The size of the exponential horns used in the average motion picture theatre, is approximately 14 feet in length; the horn being coiled or concentrated so as to take up less space, as one of the photographs clearly indicates.

It is said that one of the principal concerns interested in the talking movie field, and whose system involves the recording of the voice photographically on the same film with the picture images, intends to use dynamic speakers, placed at suitable points about the auditorium.

The Origin of Man

By Prof. Herdman F. Cleland, A.B., Ph.D.

(*Continued from page* 1131)

houses and of his body, and in other ways to create conditions so favorable to his well-being, and ideal for energy, that he will be able to overcome the enervating influence of a tropical climate? Indeed, it is probable that, soon, the tropical regions of to-day will be made ideal for a high civilization. Do we not have reason to be confident that human progress will be terminated only when the sun's temperature shall have cooled to such a degree that animals or plants cannot live on the earth, or until the earth shall have been disrupted by the passing of some great star?

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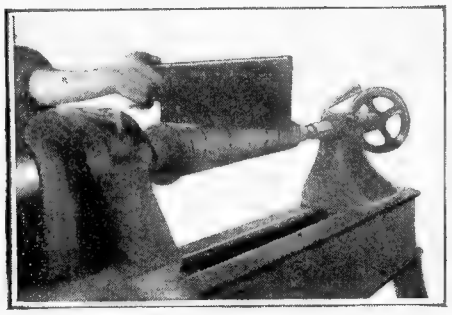
WOOD TURNING

By H. L. Weatherby

(*Continued from page* 1163)

building anything carrying a hole down through a block of any length. The ends must be plugged before turning operations are begun. The base, if a piece of wood of



The bottom of the groove is made by sawing along the spiral as shown here.

the desired thickness isn't at hand, should also be glued at this time.

A good grade of hard, close-grained wood is recommended. Both of the lamps illustrated were made of black walnut and finished natural and no matter what the material, the finished lamp should be finished, probably either in walnut or mahogany.

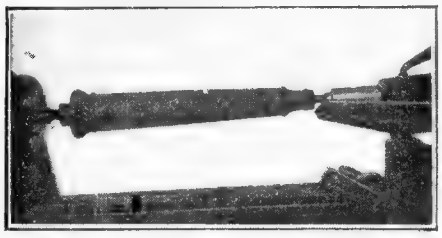
The Turning

THE actual turning is simple spindle work on the post and face plate turning on the base. A tenon must be turned on the post and a corresponding mortise in the base. After the plain turning has been done to the post we are ready to lay out the spiral.

Laying Out the Spiral

WITH the drawing at hand and the post in the lathe, measure off the sections as indicated, measuring the larger sections first and then the subdivisions. With the lathe in motion, draw lines around the post at each point. It is well to make the lines at the larger subdivisions darker, or of another color, to distinguish them from the rest.

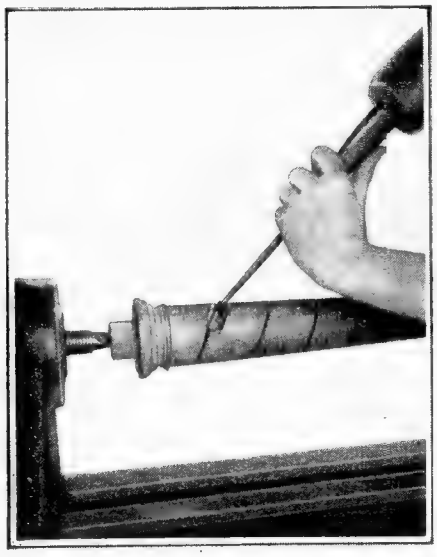
Bring the work to a stop, and with a soft pencil draw four lines lengthwise of the spiral section, dividing it into four longitudinal sections. Now draw the lines for the top and the bottom of the spiral groove freehand, from point to point and from one to the other, making a complete revolution at each large subdivision. Again, in order to distinguish the bottom of the spiral groove from the top of the same groove, it might be well to use two different colors of pencils here also. There will be no difficulty experienced in drawing these spiral lines for the points are close together and each large subdivision is divided into four parts corresponding to the four longitudinal sections.



Above, the post after sawing. The spiral is made according to the details given.

Cutting the Spiral

WITH the back saw or a small hand saw, cut around the post, following the line of the bottom of the groove, from one end to the other; care must be taken not to cut too deep, particularly at the small end. Next, with a sharp chisel, cut away material in the general shape of the groove desired,

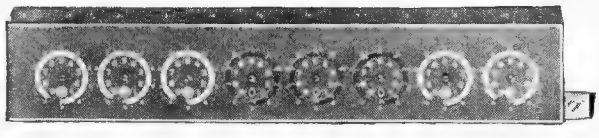


The groove is made by cutting with a chisel.

remembering to keep it rounded out in the bottom and off on top. Cutting with the saw may have to be resorted to again and further cutting with a chisel. This work should be done in the lathe and should be turned, a section of a turn, from time to time, as it progresses. The groove should be shaped out gradually at both ends. These and subsequent steps are shown in the illustrations. (*Continued on page* 1207)

Inexpensive Calculating Machine

HERE is a photograph of a simple calculating machine which adds, subtracts and multiplies accurately and with lightning rapidity. There are no keys or levers, but a stylus operates the dials. The answer is given in the circular openings just below the center of each dial. The dials are in two colors so that it is easy to differentiate between dollars and cents, or decimals. The device is equipped with a clearing lever which instantly resets the dials at zero. Made of metal, and provided with a calibrated ruler edge which will also aid in tearing paper, this device serves a multifold purpose. A mechanism of this nature should give a lifetime of service because there is nothing to get out of order.



Here is the top view of a lightning calculator which adds, subtracts and multiplies. It is made of metal and handsomely finished.

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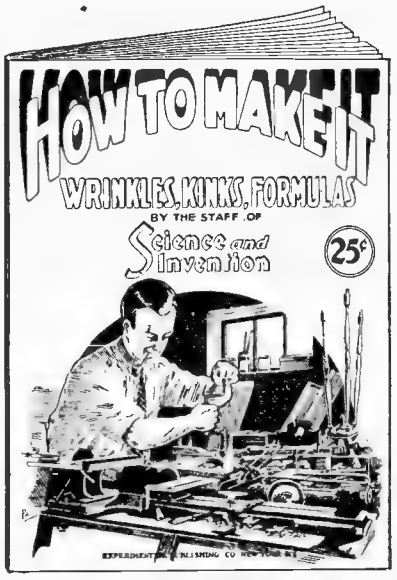

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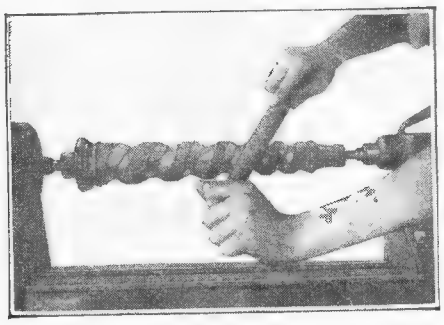
Wood Turning

(*Continued from page* 1205)



With the lathe running at slow speed, file as indicated with round and half-round wood files.

In the next steps we use the power again, and put the work in motion at the slowest possible speed, which probably will not be slow enough. The writer, in order to slow the work down from the lowest speed, used a brake and permitted the belt to slip. With a belt-driven lathe this is possible, but with a direct motor drive one must simply use the lowest speed possible.

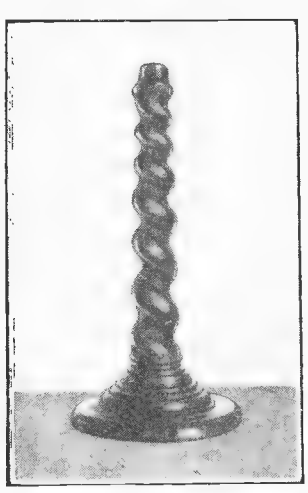
With a round wood file held as illustrated, start at one end and permit it to travel to the other, with the motion of the lathe carrying it. This for the bottom of the groove, and a similar filing with a flat or half round file for the top, and then careful sanding with different grades of sandpaper, with the work in motion will complete the post.

The base is simple face plate turning which needs no explanation. A hole should be bored from the side to carry the cord to the hole in the post. If desired, the hole in the post may be continued on through the base to a countersunk hole in the bottom, a length of ⅛" pipe may be run through the entire lamp with a nut screwed on to the bottom and a socket on the top end of this pipe. In this case a groove should be cut in the bottom of the base for the cord. The suggested method for wiring, however, is to simply drive a short length of ⅛" threaded pipe into the top end of the post after boring out the plug; and screwing a lamp socket onto the threaded end of this pipe sticking out of the post.

The post and base are glued together and after setting, are ready for finishing, suggestions for which have already been made.

The shade used will, of course, depend upon the builder's desires.

Next month we are going to tell you how to build a Banjo Clock.



The completed lamp before the shade has been put in place is shown above.

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"Rev." Ford Faked Houdini Message

(*Continued from page* 1203)

her that it had not been released and she told me that my profession should come first, that I was a —— fool.

A Trap for Mr. Ford

THAT afternoon in the office of the *Graphic* publisher, Emil Gauvreau, in the presence of William E. Plummer, the Managing Editor, I telephoned Mr. Ford. He was elated over the publicity of his séance and when I said I would like to see him, he said he was anxious to talk with me about the séance. He said that he had to attend a lecture in New Jersey, but that if eleven o'clock was not too late, he would stop on his way home that night. I told him I had to work but that I would manage to run home, if he could set a very definite time. We agreed upon 11:15 P. M.

At 11 P. M., William Plummer, Managing Editor of the *Graphic*, and Edward Churchill, a reporter, were concealed in the breakfast room of my apartment. Mr. Ford was punctual.

"Remember the peculiar party last December. I mean the one at Rockwell Palace on 8th Avenue near 159th Street, where you went with Bess (Mrs. Houdini) and I first met you as Mr. David?" I said.

"Yes, indeed," he replied, "wasn't it funny? Bess and I had a great time among those temperamental people, didn't we?"

The medium ran through a gamut of emotions, from triumph to apprehension, for it was at this point that I told him I wrote my story 24 hours before the séance was held. I showed him the carbon copy and my original notes with the code in the handwriting of Mrs. Houdini and the word "BElieve."

There was apprehension in the voice of the medium, who likes to be known as the "Rev." Mr. Ford. "But you must play ball," he pleaded. "Really, I would be glad to make financial compensation."

"Reporters never take money," I replied.

"Then I'll give you tips on big stories; I have some very prominent people who call upon me."

"I get all the tips for stories that I want."

"Then I will give you friendship—undying friendship."

"The first thing you know, David, you will be proposing," I said. We both laughed at this sally. "I understand that you and Mrs. Houdini are going on a free-lance lecture tour," I remarked.

"Well, I'm going to—I'm always making lecture tours."

"Who is financing this one?"

"Why, I am. Mrs. Houdini supplied the message and code, and I am supplying the finances."

"Then you did not get the message from Houdini?"

"You know, Rea, I could never have done that!"

"How about Joseph Dunninger's challenge?"

"Oh, that is simple; I can always say the spirit does not come through."

So many questions set Ford to speculating.

"After what the *Graphic* first printed, it wouldn't—couldn't reverse the story; now could it—" There was a pause—"The story is about dead, now, anyway, isn't it? The reporters will go away and not ask any more questions, won't they?"

"No indeed," I replied. "The story is just getting interesting. My office thinks it strange that I had my story written in advance. They are just waiting for me to get definite information and proof that it was all a hoax."

Mr. Ford Waxes "Philanthropic"

"IS there anything—anything at all I can do to make them forget it? Anything I can do for you, Rea? You just play ball and I will give you a nice big story tomorrow."

"But I am out to get a story to-night," I laughed, thinking of those concealed and what they had recorded, and who his *guide* had failed to reveal to him.

Mr. Ford took his hat and coat and went out to revive his spirits. As he left, James Lawlor, the door man, again recognized him as the man who had been addressed by me as Mr. Ford when he arrived an hour before. I walked out of the building with him, calling him by name several times.

His *good-night* was void of the hurrah that goes with the relieving of suckers of their wallets, by producing the astral form of *Sitting Bull* or *David Fletcher*, and being satisfied with ones-self.

Mr. Ford's spirit machinery back-fired, and now he is suffering from powder-burns that prevent further asinine cavorting with spooks.

The obvious purpose in the *Graphic's* exposure of this stupendous hoax is the stemming of that poor old animal on whose back so many seekers of truth have ridden to their mental and financial destruction.

* * * * * *

The Editors have affidavits to prove that Mr. Ford was in Miss Jaure's apartment at the time specified.

"Mima"—A Masterpiece of Stage Mechanics

By H. Winfield Secor

(*Continued from page* 1133)

strength, up in the fly gallery at A, plus the incidental noise caused by the collapsing of the ladders and spider galleries on the engine.

Various scenes such as of gambling parties and others are shown to Janos, each of these scenes being shown in one of the three compartments or rooms built into the base of the huge engine here illustrated. To expose one of these scenes to the audience and to Janos, also, who is standing on the stage, the steel doors gradually rise or fall, the doors being operated by electric motors in a remarkably smooth and mystic manner. The center door at the base of the engine is a masterpiece of stage carpentry and mechanics. All of the worm-screws on the front of the door, for example, rotate, and it is safe to say that no mechanical engine built for stage purposes only, has ever approached this particular specimen, when one considers that all worms and reciprocating rods actually move; the huge steam gauges shown are real steam gauges made of brass and glass.

For certain sound effects, phonograph records are played by means of an electric pick-up, and the voice currents from the pick-up are amplified through a multiple stage, vacuum tube amplifier.

In the center part of the base of the engine there takes place some of the most interesting scene changes, and these are displayed to the audience as the door with the spiral worms on it slowly rises and falls. An intricate elevator and platform system operated from the basement 20 feet below the stage, serves to raise and lower the scenes in this center compartment of the engine.

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Is the Land Afloat?

By E. T. Brewster

(*Continued from page* 1144)

In other words, the land is like ivory soap in the bath tub—it floats. *The reason why the continents are up in the air and the ocean floors down under the water, is that the continents are light and the ocean floors heavy.* As a matter of fact, when there is a volcanic eruption on an oceanic island, and the lava comes up from deep under the earth, that lava is always a heavy, black basalt that weighs ten or twenty per cent more, bulk for bulk, than the common land rocks of which we build our structures.

In the same way, the reason why the mountains are high is nothing other than the reason why a pine log floats higher in a mill-pond than a hardwood stick. It is indeed surprising that the light rocks of a mountain district should float a mile or two miles or even four and five miles above the rest of the world. But the mountains go down forty, fifty, sixty miles into the earth. A mass forty miles thick, floating four miles high, corresponds to a log ten inches through that floats one more inch out of water than another of the same size. There is much more difference than this between different sorts of wood—and there is—as anybody can see—much more difference between different sorts of rock. Mountain tops may be three miles high, with the general level of the mountain mass less than one.

The land, then, is in floating position. The question is: Is it really afloat now; or was it afloat in some distant geologic past, with everything now frozen tight? One can imagine our cake of ivory soap afloat in the bath tub. Then somebody leaves the water in the tub and the windows open on a cold night, and all the plumbing freezes up. The soap is, strictly, still floating—ivory always floats—but it is floating in ice, not water, and does not float around.

Apparently, the land is still floating free.

Take the Mississippi delta. There is an enormous mass of mud and fine sand, several hundred miles long, in the water and out, and several hundred feet thick. The river has washed it down and put it in the place of the sea. So the mud has taken the place of that much ocean water. But mud is more than twice as heavy as sea water. Therefore, ought the earth's gravity to be measurably greater on the Mississippi delta than out to sea on a vessel's deck, where the swinging pendulum has water under it instead of mud?

But it is not. On the contrary, the earth pull is substantially the same on the water and on the land.

There is only one explanation. If the earth was in equilibrium before the delta began to form and is in equilibrium now, then the light delta mud must have sunk down into the heavier rock of the sea floor, until sea floor and, let us say, a half mile of mud, just matches sea floor and a mile and a half of water—taking the one as two and one-half times as heavy as the other.

There is a vast amount of evidence that goes to show that deep down in the earth, something like forty to sixty miles, there is a plastic layer of basalt, solid indeed to quick strains like daily tides and momentary earthquake waves, but capable of flowing like pitch under steady pressures that continue for a thousand years. If, then, the earth is loaded in one spot—as when a great delta is being formed—down it sinks at that spot. If it is unloaded at any spot—as when the great ice sheet melted off at the end of the Ice Age—up it bobs at that spot. In fact, we have long known that certain coasts are rising now, and certain others are sinking.

No possible doubt, then, that the lands are floating up and down. The great question is: Are they also floating sideways?

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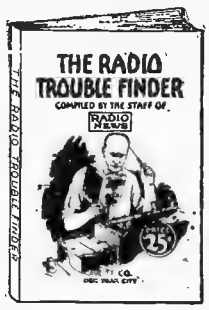

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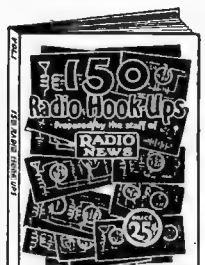

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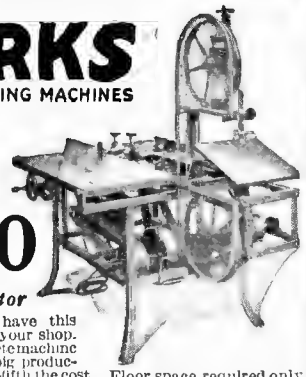

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A One-Man Submarine

By Frederick C. Jones

(*Continued from page* 1141)

acting bolt which passes from the base of the cabin into the hull of the vessel sufficient to hold the cabin. One of the bolts is actuated by an electro-magnet on the base of the lever which transmits its movement through a small pinion to the second bolt, a discharge of compressed air thrusts the cabin upward and free of the vessel.

Other Features

THE large jack socket on the cabin is protected by a water-tight sleeve against the action of the water.

The "taxi-sub" is driven entirely from storage batteries coupled direct to a motor-driven propellor, submerging, diving and cruising being carried out the same way as in the larger type. The cruising period is limited to four hours off the main battery and one hour from the emergency, it would then return to its ship or fort for recharging.

Two torpedoes are carried forward, these lie side by side in two compartments, when firing, the torpedo doors are opened and the chambers flooded. A spring then forces the torpedo forward and a trip mechanism starts the driving apparatus in the torpedo. A sighting vane gives approximate direction and as the "taxi-sub" can approach much closer than the larger type a hit is assured.

All cables pass around the cabin and all controls are electro-magnetically operated through the jack plug from the cabin, and in the event of the cabin being released there will be sufficient power exerted by the cabin to pull itself free of the jack plug.

RULES FOR MODEL CONTEST

(*Continued from page* 1160)

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2. Models of all kinds may be entered. They may be working models or not, according to the subject that is being handled.

3. Models may be made of any available material, preferably something that is cheap and easily obtainable.

4. Models must be submitted in all cases. Good photographs are also highly desirable, and where the maker does not desire the model to be taken apart, legible drawings with all dimensions covering parts that are not accessible must be submitted.

5. Models should be securely crated and protected against drainage in shipment and sent to us parcel post, express or freight prepaid. Models will be returned when requested.

6. Models for entry in any particular contest must reach this office on or before the 25th of the third month preceding date of publication. For instance, models for the June contest must reach us on or before the 25th of March.

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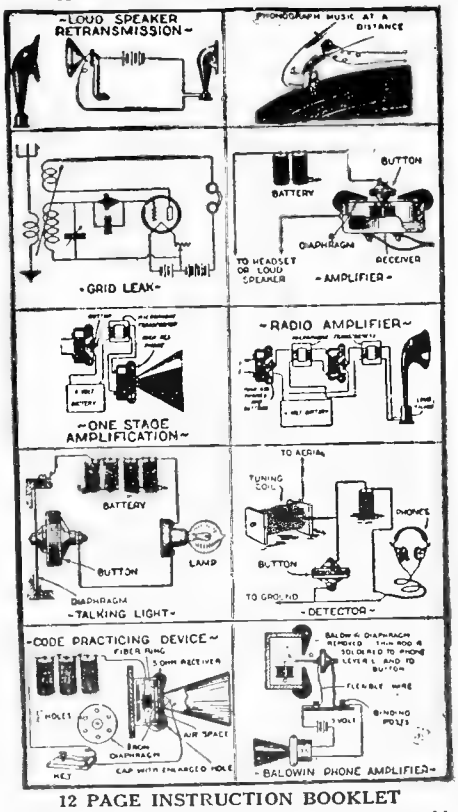

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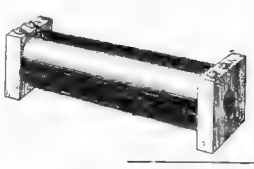

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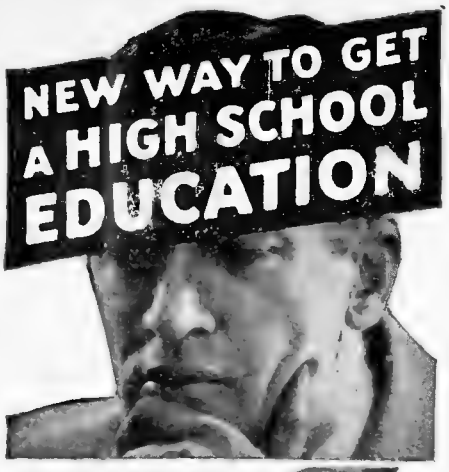

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Motor Hints

Conducted by George A. Luers

(*Continued from page* 1154)

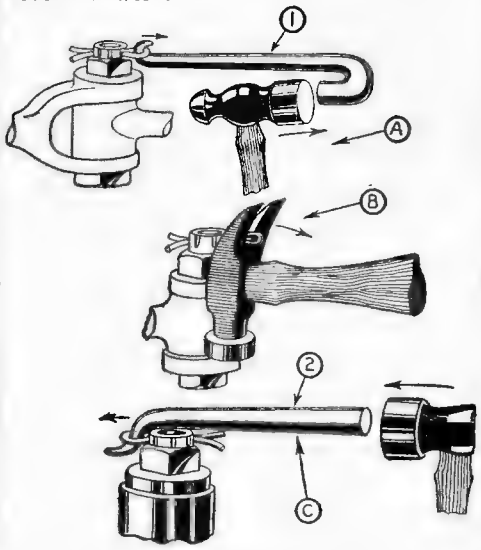
The three simplest and most expeditious means for removing cotters, the writer has come in contact with, are shown in the attached sketch.

The first illustrated is a steel hook having one end bent for striking with a hammer. This is for close places, where the cotter must be pulled.

The second method, illustrated, is the simple use of a claw hammer to snag out the cotter. This means serves around steering gears and exposed parts of the brake system.

The third method shown is by means of a driving tool. The tool is a steel rod with an "S" shaped point.

Such simple tools as these are recommended as means to quicker repairs and overhaul work.



Above—extracting cotter pins. 1, *steel rod,* A, *strike tool in direction of arrow,* B, *pull with hammer,* C, *another form of striker tool,* 2, *steel rod.*

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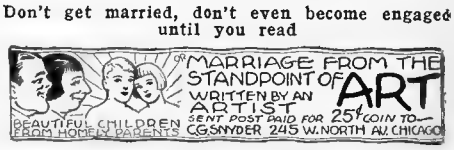
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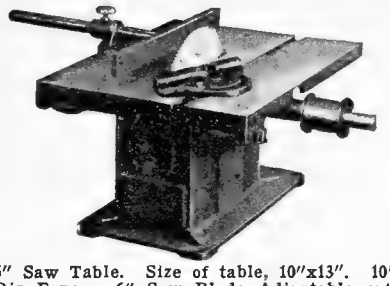

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By J. E. Lovett

(*Continued from page* 1161)

carcase is 3 feet 4 inches long by 1 foot 7 inches wide and is screwed to the top rails and runners. The back may be of ¼-inch plywood, rebated into the ends and screwed to the ends, division, bottom, and top back rail. The plinth moulding is 3½ inches wide and is fixed around the ends and front, the corners being mitred.

The shelves in the right-hand side of the lower carcase may be of ½-inch timber resting on cleats; they may then be easily fixed at any desired height. The draw-out shelf should run between two cleats, and should be strengthened with a couple of battens nailed on the under-side, while a small slip of wood nailed under the front edge will be helpful when drawing out the shelf.

The door is framed with two-inch stiles and 2½-inch rails, mortised and tenoned together, and the plywood panel is grooved into the framework.

The drawer fronts are ⅞-inch thick, the sides and backs ½-inch, and the bottoms ¼-inch. The sides are dovetailed to the fronts and backs, and the bottoms grooved into the sides and fronts and nailed to the backs.

Upper Carcase

IN making the upper carcase, prepare the ends, top, bottom, and main shelf. The latter is tenoned or dovetail-grooved into the ends, and the top and bottom are dovetailed. It should be noticed that the bottom stands in one inch from the front edges of the ends. The upright divisions, one of which is fitted at the side of the flour canister, and the other to divide the space at the top, are grooved into the bottom, main shelf, and top. The back, which is again of ¼-inch plywood, is rebated into the edges of the ends, and screwed to the bottom, top, main shelf and the upright divisions. The shelves which are fitted to the interior of the upper carcase are of ½-inch timber, and should rest on cleats. The cornice moulding is 1½ inch square, mitred around the top. The hinged flap is framed with 2-inch stiles and 2½ inch rails, mortised and tenoned together. The ½-inch panel is grooved into the edges of the framework, and it should be recessed a little so that a piece of thick plain linoleum may be glued to the upper surface. The doors at the top are framed with 1½ inch stiles and 2-inch rails, mortised and tenoned together and grooved for plywood panels.

Flour Canister

The flour canister may be made in ¼-inch wood. The two ends are cut to the dimensions shown in the drawings, and the upright and sloping portions of the back and the bottom are nailed on. Wedge-shaped blocks of soft wood, 3 inches wide by 2 inches high, are fitted over the bottom at the sides to form a slope to the outlet in the bottom, which is 1½ inches in diameter. If desired, thin sloping pieces of wood could be fitted in place of these blocks. The front is pinned to the edges of the ends and bottom. The small shutter which covers the outlet should be shaped as shown in the drawings, fitted with a small knob, and fixed under the bottom with a round head brass screw. Two fillets are screwed to the top of the ends, and the canister runs on small cleats screwed to the end and division of the carcase. The upper and lower carcases are screwed together.

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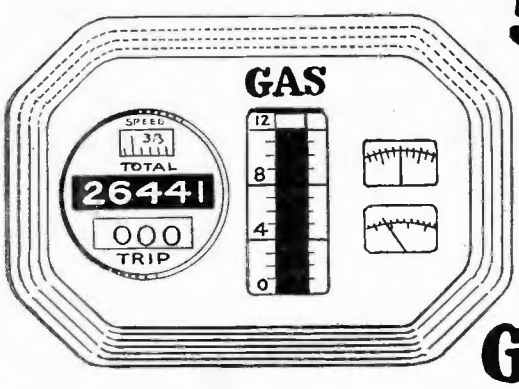
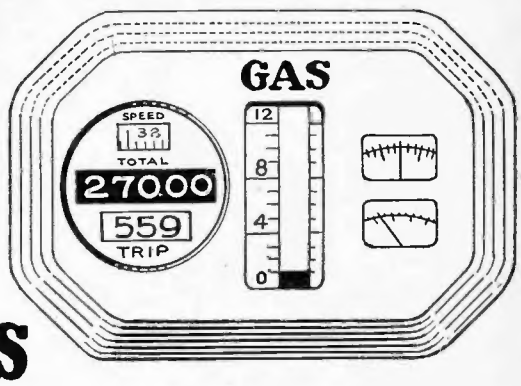


559 Miles on 11 Gallons of GAS



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R. J. Tulp: "The Whirlwind increased the mileage on our Ford truck from 12 to 26 miles to gallon and 25% in speed. We placed another on a Willy's Knight, and increased from 12 to 17 miles per gallon.

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